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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY.

Vol. 31. 505 PEARL STREET, NEW YORK. No. 12.

Index to Advertisers and Classified Index Following Reading Matter.

BORING MILL ACCESSORIES

THE BULLARD MACHINE TOOL COMPANY, BRIDGEPORT, CONN. U.S.A.

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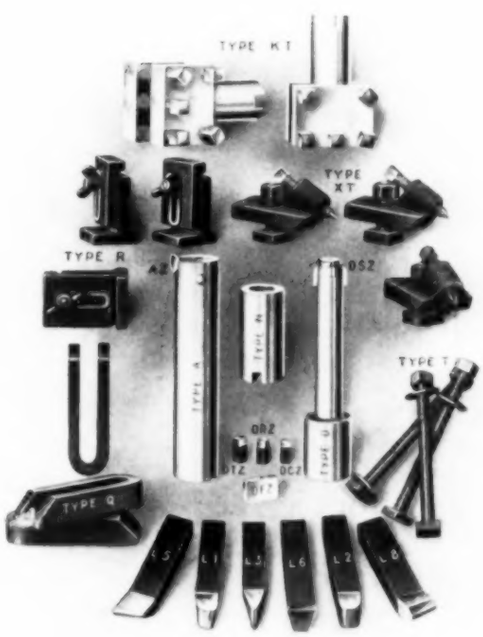
TOOL EQUIPMENTS FOR BORING MILLS

The Productive Capacity of a Machine is Governed by the Character of its Tool Equipment . . . . .



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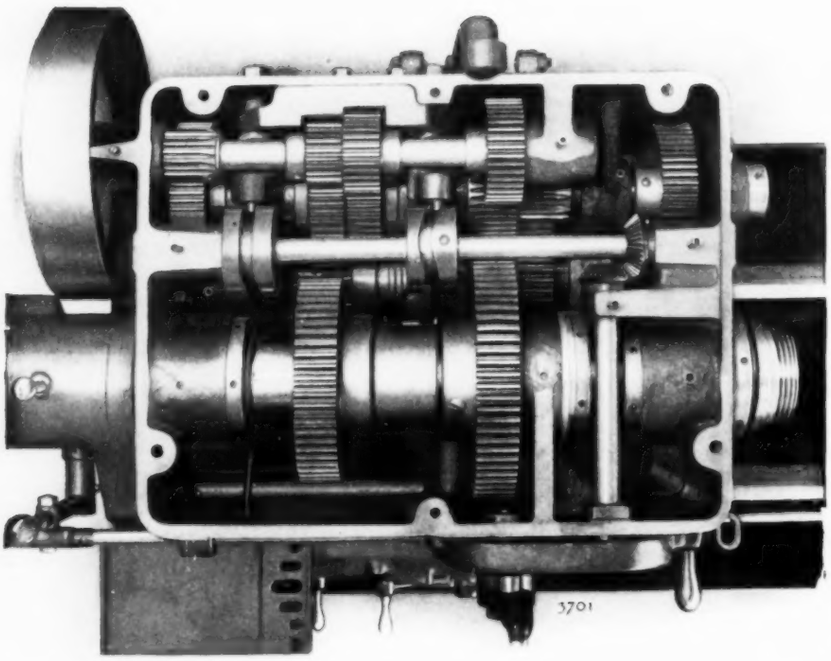

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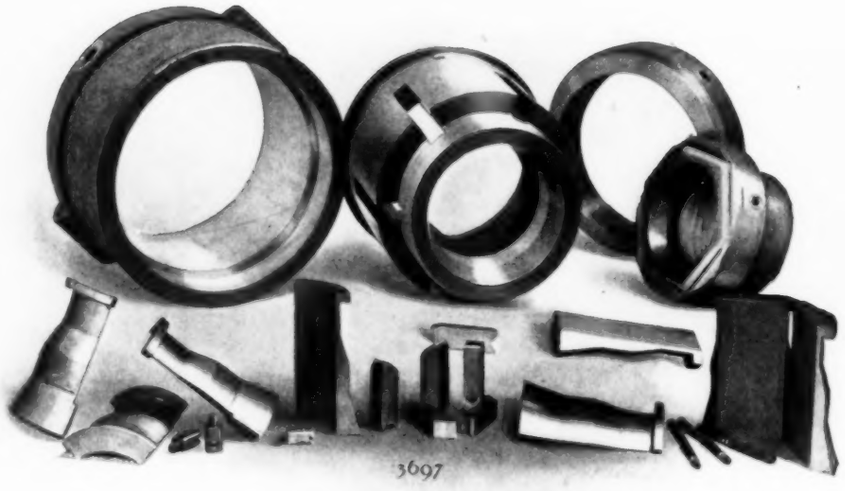

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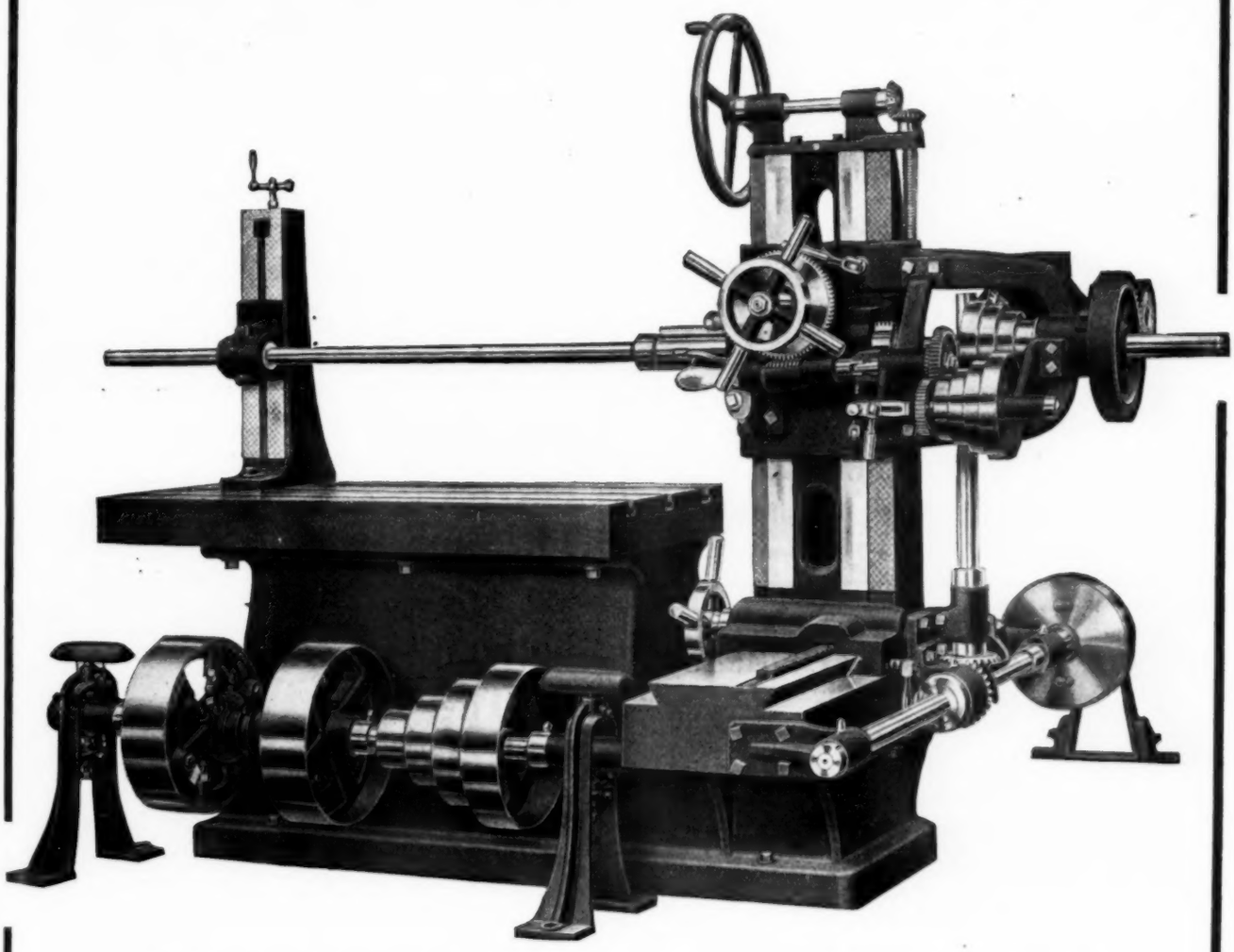

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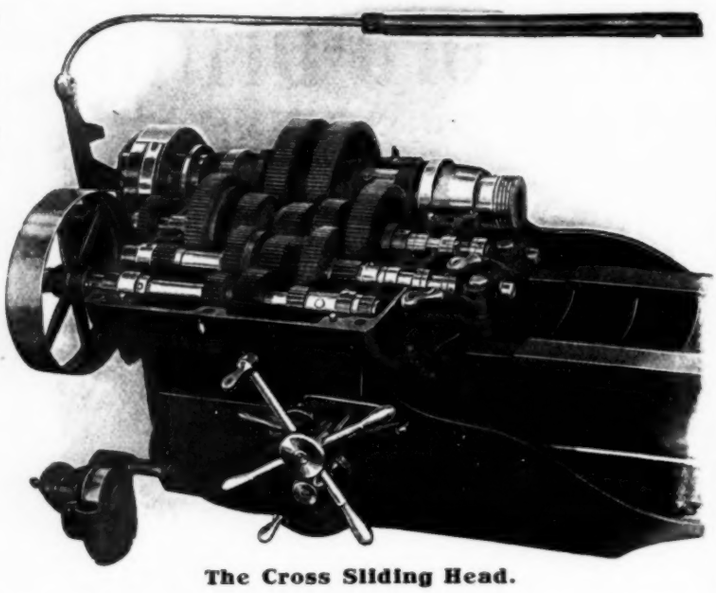

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See Pages 12 and 13 for more "Flat Turret" points.

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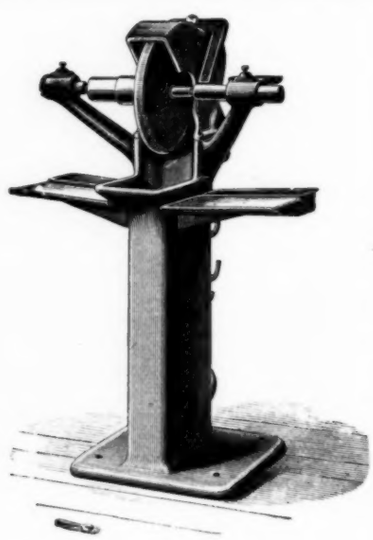


The stand may be connected with a blower and the dust completely removed.

This is but one of its conveniences, shall we tell you of the others?

Builders Iron Foundry,

Providence, R. I.

Effective Machine-shop Organization

How Westinghouse Elect. and Mfg. Co. Fixed Responsibility, Increased Productive Periods and Floor Space and Decreased Clerical Labor

BY ALEXANDER TAYLOR*

In a manufacturing establishment, whose product is large in volume and varied in character, the organization of the different departments, including their geographical and their administrative arrangement, is a matter of great importance, both from the standpoint of rapidity and volume of output and of economy of manufacture. Next to the personnel of the working and governing forces, I consider this question of inter-departmental arrangement to be one of prime importance.

It goes without saying that no general rules governing the formation of such an organization can be laid down which will fit all, or even the majority of cases. The changes which are being made in the works organization of the Westinghouse Electric and Manufacturing Company, of which this article will treat in a brief way, have been made necessary by the great increase in the volume and variety of the company's output. While they are not generally applicable, there are certain principles involved which may be of interest and possibly of use to other factory managers.

It is considered good practice in modern manufacturing plants to follow the plan of grouping like machining operations together and under the same supervision. We see frequent illustrations of interior views of new factories showing departments devoted to milling, planing, automatic screw machinery, punch presses and many other types of machine tools. The idea behind this arrangement is that, in this day of specialized knowledge, our foremen become specialists in lathe work, planer work, boring-mill work and the like, and we are, therefore, the gainers in speed and accuracy of output if all our work of a given class can be supervised by the one man in our organization who knows the most about that particular kind of work. Furthermore, this grouping makes it easier to keep all of our machines busy, and as a consequence to turn out the output with the least equipment. There are, also, other advantages such as, economy in floor space and in the distribution of power, uniformity in handling equipment, etc. These advantages are real and important and, under the conditions surrounding the majority of manufacturing plants, are of such relatively great importance as to decide the question of departmental arrangement.

There is, however, a point in the growth of the establishment where the advantages of the above-mentioned arrangement become of less moment than the difficulties attending its operation.

As the plant increases in size, there becomes necessary such a volume of interchange of finished materials between departments with its corresponding clerical work and such a multiplication of foremen and superintendents concerned in the manufacture of any one class of product, that there is involved delay and loss of time, a lack of definite centralized responsibility and a volume of clerical work which, in its evil effects, is sufficient to overbalance the many good features of the departmental grouping which we have just considered. To make any statement as to when this critical period is reached for any given establishment would be manifestly impossible; but that such a point will be reached in the growth of every manufacturing concern at some stage in its development, I am firmly convinced.

Original Scheme of Organization

Until recently the East Pittsburg Works of the Westinghouse Electric and Manufacturing Company has been divided into assembling and feeder departments; each department reporting to an assistant superintendent who, in turn, reported to the superintendent. Each assembling department turned out a different class of apparatus; one assembled railway motors; another, large motors and generators; a third, small motors and generators; a fourth, transformers, and so on. In a similar manner the feeder departments were divided according to class of output; as, for instance, a department for the making of coils for all purposes, including coils for railway motors, industrial motors, transformers, instruments, etc.; a department for punch-press work for all purposes; a department for commutators; another for brush holders and so on throughout the entire range of detail parts. In each department was grouped all of the regular and special equipment necessary for each class of output. The heads of each department were the men of largest experience and most expert in that line.

This arrangement has been in operation for a considerable period, was adhered to closely and worked well. But we began to find out that with increase in size and variety of output the disadvantages multiplied. In the first place no man below the superintendent could be held entirely responsible for the output of any one class of apparatus. Below him many men were involved; a considerable amount of interchange of product and clerical work was necessary for the manufacture of each piece of apparatus. For example, the department assembling small motors was dependent upon another department for coils, upon another for punchings, upon another for brush holders and upon others for commutator, core and wood details; all these without mentioning the part of the foundries in supplying brass, iron, malleable and steel castings. In many cases there were several transfer steps to be made before the parts reached the assembling department. All these involved cost of handling, clerical work and large opportunities for delay. An increase in the demands of one assembling department upon a feeder department would often make it impossible for the latter to keep the promises made to other assembling departments, with a consequent tieing up of material in a partly finished state and of floor space in various parts of the works. While a carefully devised production system was in operation to make proper provision for delivery dates and keep track of delays, the whole arrangement was such as to invite trouble.

Reorganization Scheme

After exhausting all means of bettering the conditions under the existing departmental arrangement it was evident that the remedy lay in a complete reorganization of the works into a number of separate and self-contained shops, each consisting of an assembling department, together with such portions of the existing feeder departments as was necessary to supply their needs.

Aside from the serious shuffling of departments which would be occasioned by this change and the necessity of making the change without interruption to business, the most important matter which had to be considered was the necessity for separating the equipment and personnel of the feeder departments into a number of parts, and distributing them in different localities near their respective assembling departments. A canvas of this matter, however, assured us that each feeder department was large enough, and possessed sufficient equipment and expert supervision enough to enable us to make the division with but little increase in tool equipment, and without serious loss due to the sub-division of our foremen.

Results Expected

By the change it was expected that the following important results would follow:

1. A localizing of authority so that all

*Manager of Works, Westinghouse Electric and Manufacturing Company.

of the manufacturing operations for each class of output could be controlled from a single point and by a responsible head.

2. A decreased manufacturing period and consequent increase in output per unit of space and equipment, by avoiding the numerous transfers of material between widely separated points. This was to be made possible by localizing the feeder equipment adjacent to the various assembling floors.

3. A decrease in the amount of "work in progress." This would result from the complete control exercised by the assembling department over the feeder equipment, so that work once started would not be held up on account of the failure of some of the parts to be ready in time. The feeder equipment would be ample to take care of the needs of the assembling department, and would not be engaged in work for any other department.

4. An increase in available floor space as a corrollary to the above.

5. A decrease in the volume of clerical work due to less interchange of material between unrelated departments.

6. A decrease in the amount of handling labor.

Following out this new plan the works has been entirely reorganized, departments divided and redistributed so that, with the exception of one or two departments in which the product and equipment are very special, we will soon have the works divided into a number of shops, each practically self-contained and each devoted to the manufacture of a distinct class of apparatus. Each new department will be handled by a manager, who will be in close touch with the sales and enginering departments in order to keep posted on the requirements of the trade, and the new designs of the apparatus which are contemplated. Under him will be a superintendent, who will have the immediate direction of the manufacturing operations.

At the present writing several such new departments have been created and the results have fully justified our expectations. While it is not to be expected that these results will exactly repeat themselves, we are able to show a material increase in output with no additional amount of tools or men, and with a decreased "work in progress material" account. We are confident that similar results will be shown as the other departments are reorganized.

Summary of Advantages

To summarize the advantages of the new plan as applied to our own plant: We expect to secure, first, a centralization of responsibility for the output of each class of apparatus; second, an increased production and decreased manufacturing period; third, a decrease in the "work in progress material" account; fourth, an increase in available floor space; fifth, a decrease in clerical work; and sixth, a decrease in handling labor.

A further advantage which might be mentioned as being of interest is the comparative ease with which, under the new arrangement, the overhead charges can be distributed to each class of apparatus, thereby giving more accurate costs.

Special Features of Recent Boring Mills

The modification of standard tools for special work is usually preferable to having special tools built, both on account of first cost and the fact that the tool is available for regular work should the special work be changed or available.

Fig. 1 shows a 42-inch boring mill arranged to do thread cutting with the left-hand head for a special job so that the work need not be taken to another machine to be threaded. The half nut is fastened to the bar in any desired position and is closed on the lead screw in the usual way by the small crank shown.

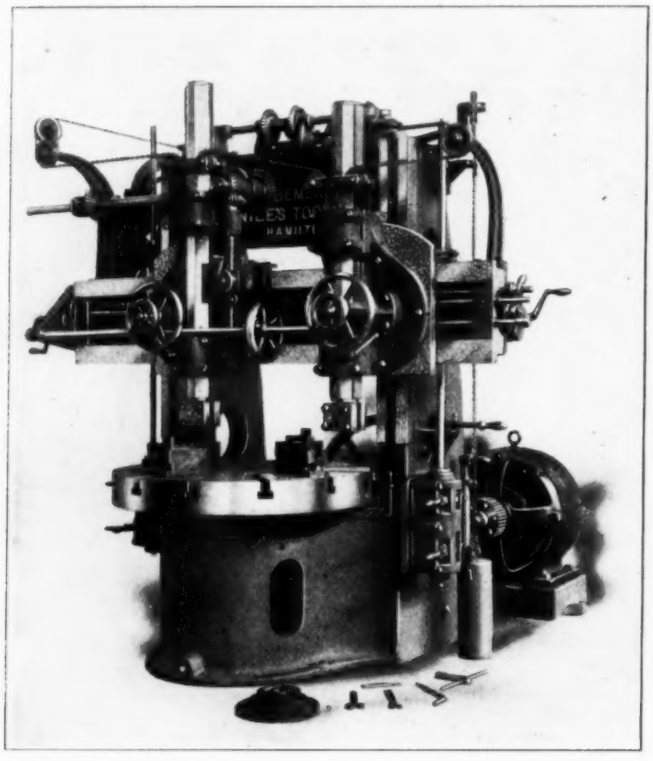


FIG. 1. SCREW-CUTTING ATTACHMENT ON LEFT HEAD

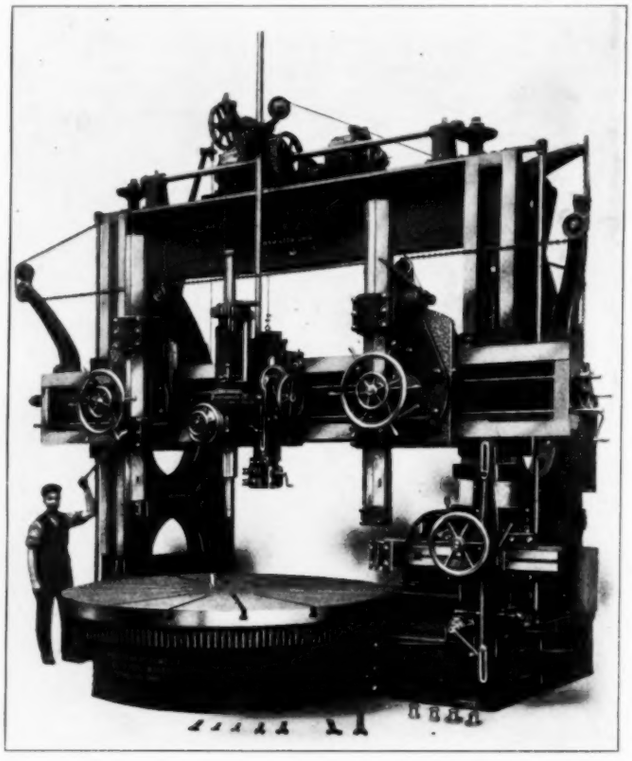


FIG. 2. 12-FOOT MILL FOR FLY-WHEELS

Thread-cutting Attachment

The lead screw is driven from the vertical splined-feed shaft at the left through a pair of bevel gears not shown but just below the collar above the cross rail. These bevels drive a short shaft at right angles to the cross rail and carrying change gears which drive the shaft carrying the bevel at the upper right-hand corner of the frame.

This pinion drives the short horizontal shaft above and parallel with the cross rail which in turn drives the large bevel behind and over the lead screw and the rest is very plain. By putting all this mechanism at the back of the frame everything is left clear for the regular operation of the tool, the thread cutting being a special attachment which is only used on occasional work.

Fly-wheel Work

Boring and turning fly-wheels is the sole object of the 12-foot machine shown in Fig. 2. In addition to the regular heads the head at the side is used to crown the pulley and is under control of the crown or radius bar shown. In this particular case the same crown is used on all pulleys turned on the machine so that only one bar is necessary, but this could easily be varied by substituting other bars with a different radius.

Between the main heads on the cross rail is an independent boring head with a separate motor at the top and having its own sets of feeds so that the boring is at all times absolutely independent of the work of the other heads. This allows an economical cutting speed to be used on both the rim and the bore at the same time which cannot be done in any other way. At the side of the central head is an auxiliary slide carrying a small tool slide for facing the hub at the same time it is being bored. This has both hand adjustment and power cross-feed.

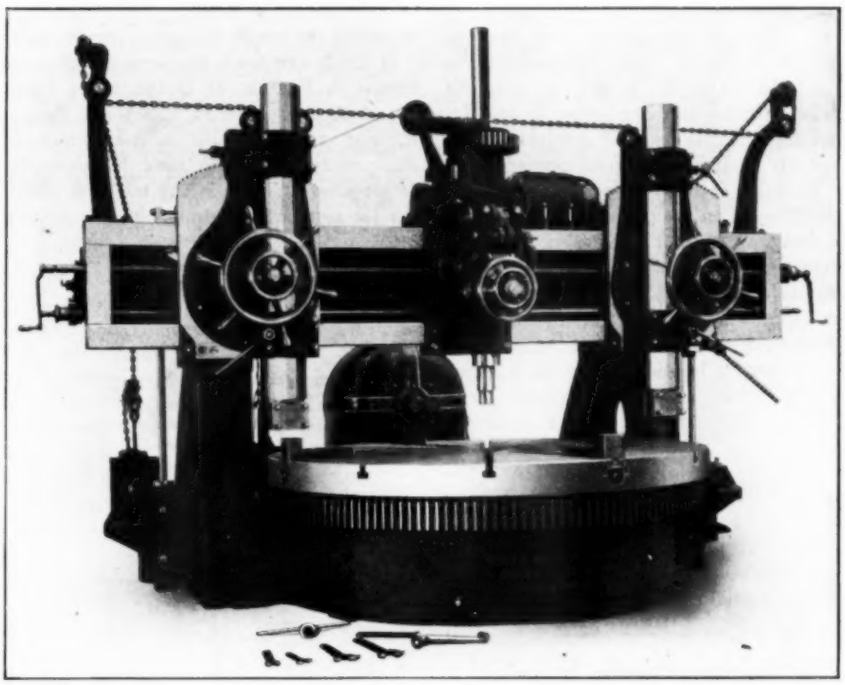


FIG. 3. FOR LOCOMOTIVE TIRES AND WHEEL CENTERS

For a Railroad Shop

Fig. 3 is equipped for a railroad shop, the Chicago Northwestern at Chicago, to handle general work and particularly for boring and turning locomotives and wheel centers. For this work it has four universal or self-centering chuck jaws which can be removed if desired for other work. This also has a central boring head for wheel centers which is independent both as to power and feeds. This head can be moved out of the way so that the hub can be faced at the same setting.

After the center is bored and the outside turned, the table is stopped and clamped, the center boring head moved over and the crank-pin hole bored with the same head. This is not used in boring and turning tires or on general work.

The Taper Attachment

Another railroad shop, the Central of Georgia at Savannah, has the machine shown in Fig. 4. This is also motor driven but the motor was not in place when the photograph was taken. This also handles tires and wheel centers up to its capacity—51 inches—but the particular feature is the arrangement for turning the

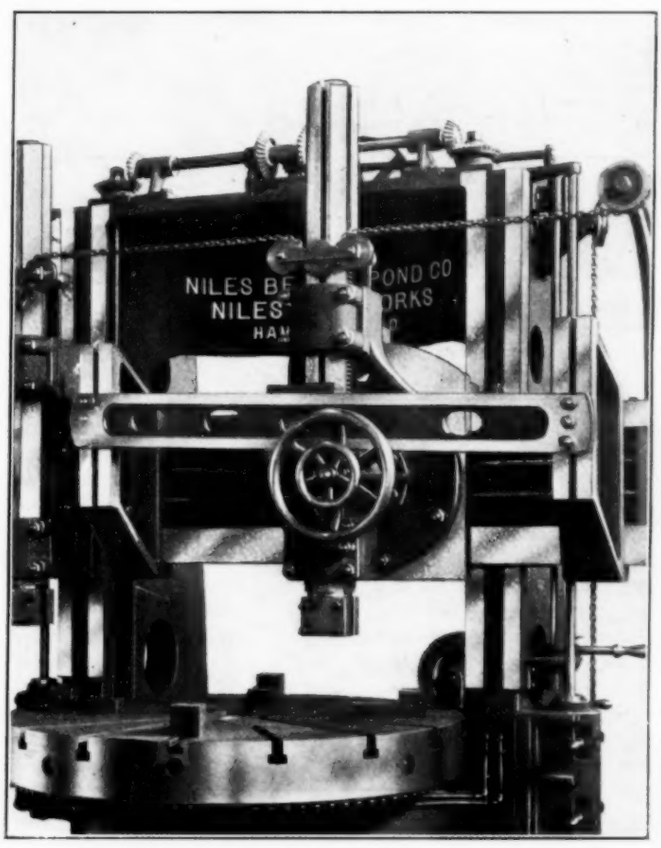


FIG. 4. TAPER ATTACHMENT FOR BORING PISTONS

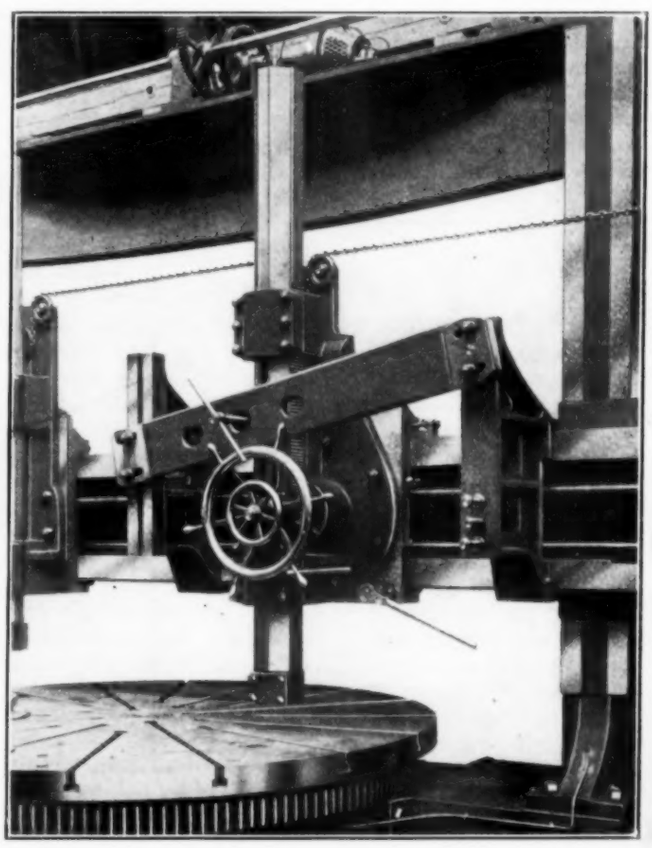


FIG. 5. ANOTHER TAPER ATTACHMENT

faces of the piston heads to the desired taper. This is accomplished by the bar which is set at an angle in front of the right head. This bar is supported by the brackets shown and can be set to any desired angle within its limit and in this way guides the bar up or down according to the direction it moves, so as to form the desired taper on the piston. The T-slot in the front of the bar enables the slide to be clamped at any point that is most convenient for the work in hand.

A somewhat similar arrangement is shown in Fig. 5, the difference being in the manner of holding the guide bar and the way in which it locks the cutter bar to it. The right end of the guide is located by the pins while the other end moves up or down to the desired position. The guiding surfaces are on the back side of the guide bar and the slide can be locked to the cutter bar at any point as before.

The machines shown are products of the Niles-Bement-Pond Company.

A Multiple-spindle Sub-drill

By F. H. Stead

The illustrations show a sub-drill used in connection with a single-spindle Davis drill. This machine is designed to drill 22 holes at once in an aluminum casting, 13 from the upper side and 9 from the lower, in the same time required to drill one hole of the same depth with the single-spindle drill. After running this machine six months, drilling approximately 44 holes, or two castings per minute, maximum depth 7/8 inch, it proved to be in good condition and handled the work very satisfactorily.

Fig. 1 shows a general view of the front and side. *A* is the cast-iron base with four hardened and ground guide rods *B* on which the upper and lower heads slide. *C* is the lower head, carrying spindles, as shown in Fig. 2. *D* is the upper head, of which a section is shown in Fig. 3. *E*, Fig. 1, is the jig holder, which is clamped to the guide rods *B* by means of set-screws *F*. *G* is the table on which the jig rests while taking out and putting in the piece to be drilled. The jig, which is not shown, is made with flanges on each side to fit into the jig holder at *e* and stopped by means of the pin *e'* in the jig holder.

Referring to the side elevation, Fig. 1, the method of operating the two spindle heads can be readily seen. Two connecting bars *J* have rack teeth cut on their

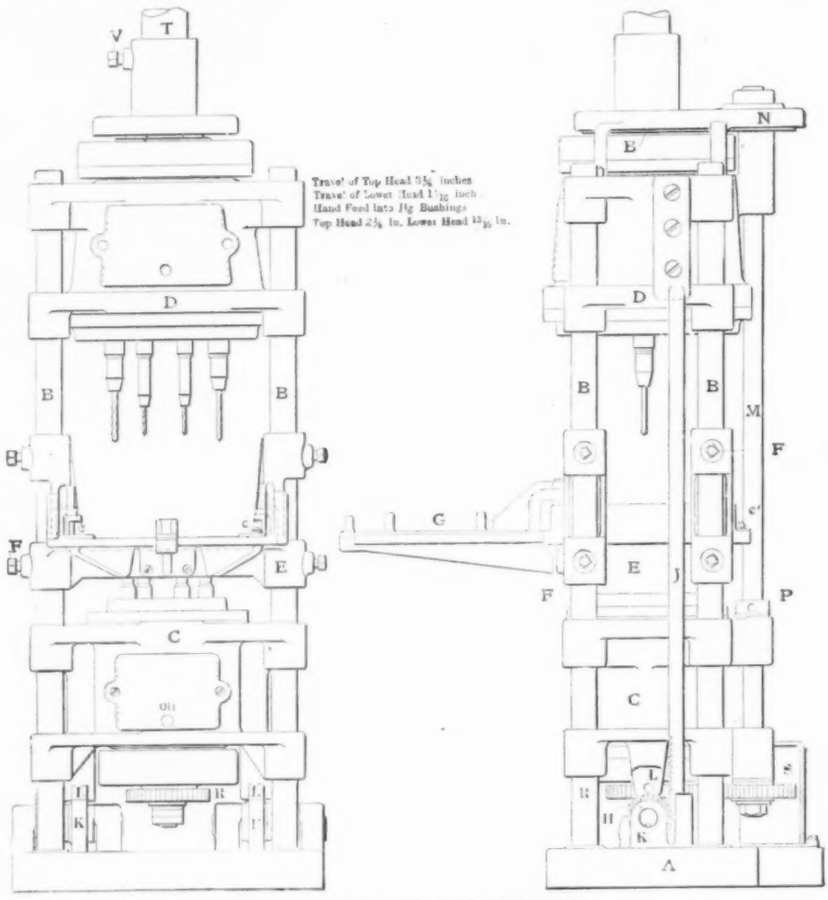


FIG. 1. FRONT AND SIDE ELEVATIONS

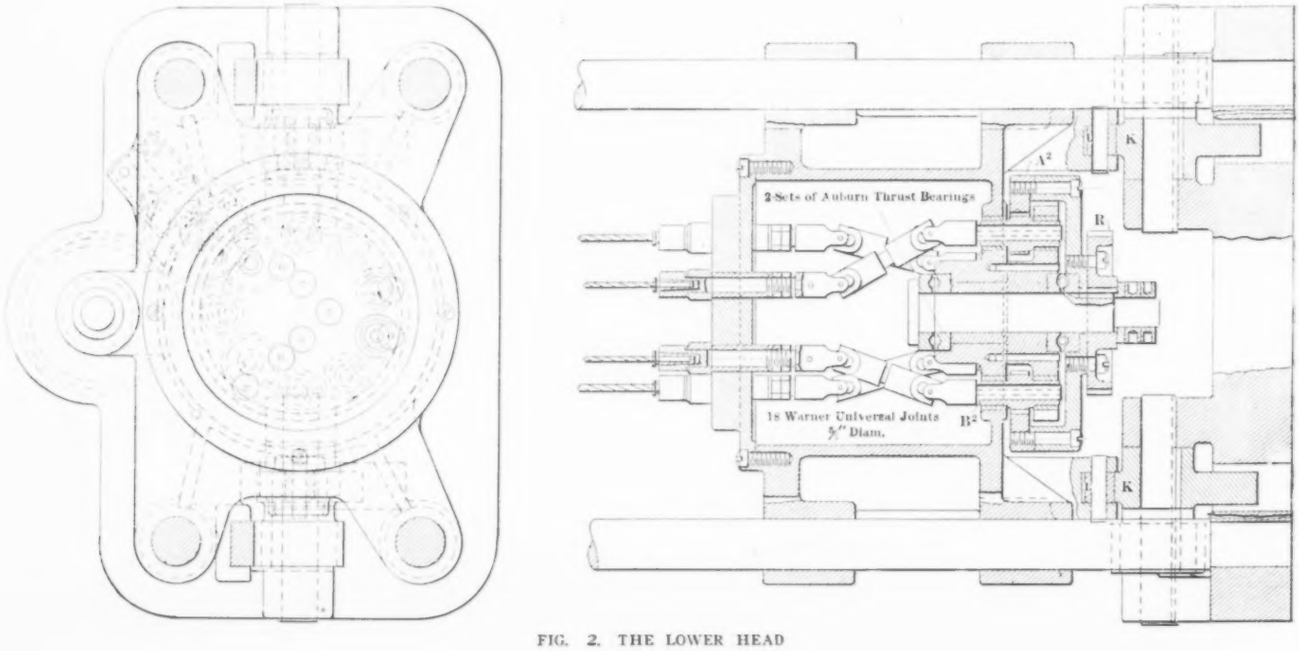


FIG. 2. THE LOWER HEAD

lower ends. These racks operate gears *H*, which in turn operate cams *K*, Figs. 1 and 2, on the same shaft. The lower head *C* is raised by means of rolls *L*, Figs. 1 and 2, which come in contact with the faces of the cams *K*.

It will be observed that the connecting bars *J* are securely screwed to the upper head; thus when the upper head is forced down by means of the power feed of the machine which drives it, the lower head rises in the proper proportion to give the desired feed per revolution of the drills. The upper head is driven by means of an internal gear hung on Auburn ball bearings, as shown in Fig. 3, *A'*. The lower head is driven through the spline shaft *M*, Fig. 1, by means of spur gear *B'*. The spline shaft slides through the pinion *N*, Fig. 1. The latter having been fitted with a key to drive the spur gear *S*, Fig. 1, not be necessary to use extreme care in regard to the bearings. The idea of using ball-thrust bearings proved very effective in this case, owing to the extra friction created by forcing down at the same time that the driving gears are rotating at a high speed. The lower head, shown in Fig. 2, is fitted with bearings practically the same as those in the upper head. Referring to Fig. 3, the spur gear *B'* is keyed to the shaft *F'*. It will be noticed that the coupling *G'* is fitted to both the gear *B'* and the shaft *F'*, thus insuring a firm drive. The coupling *G'* is bored to fit over the spindle of the drilling machine with which the sub-drill is used (see *T*, Fig. 1), and held in place by means of three set-screws *V*.

To guard against the possibility of running the drills down into the jig before the latter has been shoved back against the stop pin *c*, thus breaking the drills by coming in contact with the hardened-steel bushings in the jig, a stop pin was inserted in the lower head cap which carries the spindle bearings. This pin was made the proper length to stop against the lower side of the jig a little ahead of the drills. A bushing was then provided in the jig to aline with the pin when the former was properly located.

The maximum surface speed of drills is approximately 115 feet per minute, using Novo high-speed drills at 0.005 feed per revolution of the drills. This speed worked very satisfactorily in aluminum-alloy castings. This metal is somewhat harder than pure aluminum and consequently does not stick to the drills like pure aluminum. After a great deal of experimenting I found this surface speed to be as high as could be used to advantage.

In building this machine fountain oilers were provided to supply each bearing. The heads are so constructed as to form an oil well in each, the upper one taking care of the spindles and the lower one supplying the pinion bearings. It was found on assembling that the heads of this machine very nearly balanced.

Fiber Friction Washers

By H. A. Burt

The article by J. G. Wood, page 957, Vol. 30, Part 2, giving the result of the use of this fiber on the timer was evidently as stated, but the cause surely not so, as the wear is almost entirely due to the breaking of the circuit, which arcs at each revolution, causing an intense heat that no known substance will withstand.

In my experience with gasolene engines, and I have experimented and worked with thousands of them, I find nothing better than fiber provided, however, the brush or contact spring is made of brass or copper.

Those using steel especially hardened, in any form, soon become pitted, forming a file which soon wears away the contacts.

There is no remedy for this burning, as I term it, and the best timer is one that is easy to take apart and assemble, simple and with inexpensive renewable contact parts. If there be any doubt as to the question, let Mr. Wood put the same timer on a shaft and run it without the electric current and I will guarantee it will not show any wear to speak of in six months, provided properly oiled while it is in actual use on the engine.

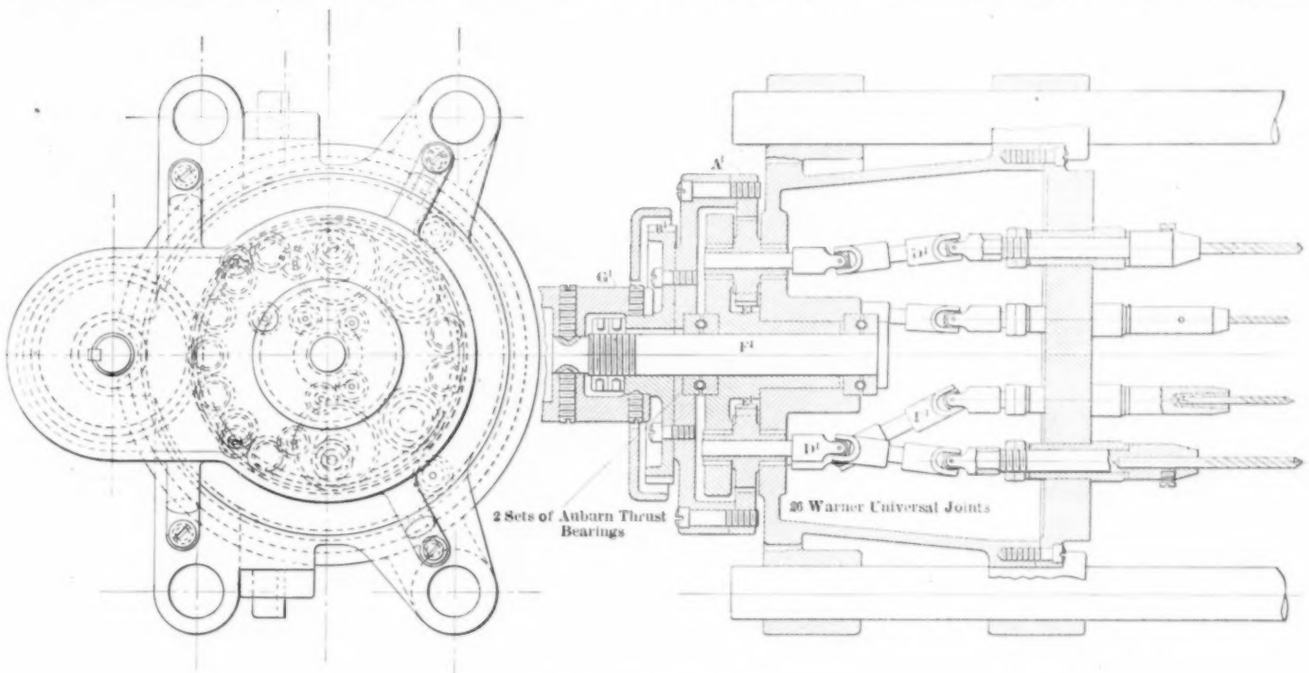


FIG. 3. THE UPPER HEAD

the lower end of the spline shaft *M* is fitted into bearings in the lower head, as shown in Fig. 1, having the thrust collar and washer *P* with gear *S* keyed to the lower end. The gear *S* drives the gear *R*, Figs. 1 and 2, which in turn drives the internal gear *A*, Fig. 2, thus operating the spindles by means of the pinions B^2. It was necessary to run an idler between the gears *S* and *R* in order to get the right direction of travel for the spindles; this idler is shown in Fig. 2 at C^2.

Referring to Fig. 3, it will be observed that the spindles are driven by universal joints *D'*, the driving ends of which are splined into the pinions *E'*, which are of machine steel, hardened and ground to fit phosphor-bronze bushings. The spindle bearings are also of phosphor bronze, with spindles ground to run true therein. It will be understood that this drill is designed for high speed; otherwise it would

The New Works of Hans Renold, Limited

Details of Equipment Are Worked Out on an Unit Interchangeable System and Present a Most Effective Arrangement

BY J. W. CARREL

The accompanying line engraving, Fig. 1, and the half-tones, Figs. 2 to 7, inclusive, show the new works not yet entirely completed of Hans Renold, Limited, Burnage lane, Manchester, England. The general plan shows the layout and correlation of the various departments, while Fig. 2 puts before us the type of the building construction. The main building is 800 feet long, 240 feet wide and one story in hight with a saw-toothed roof. Adjoining it on the northern side are small buildings for the boiler house, fan and heater chamber and a hardening room. Fig. 2 was taken from the southern side before the plant was completed, and thus does not show the administration building. The general character of the interior is well illustrated by Fig. 3. The excellent natural light is, as would be expected, a noticeable feature. The distance from the observer to the far end of the building is 740 feet.

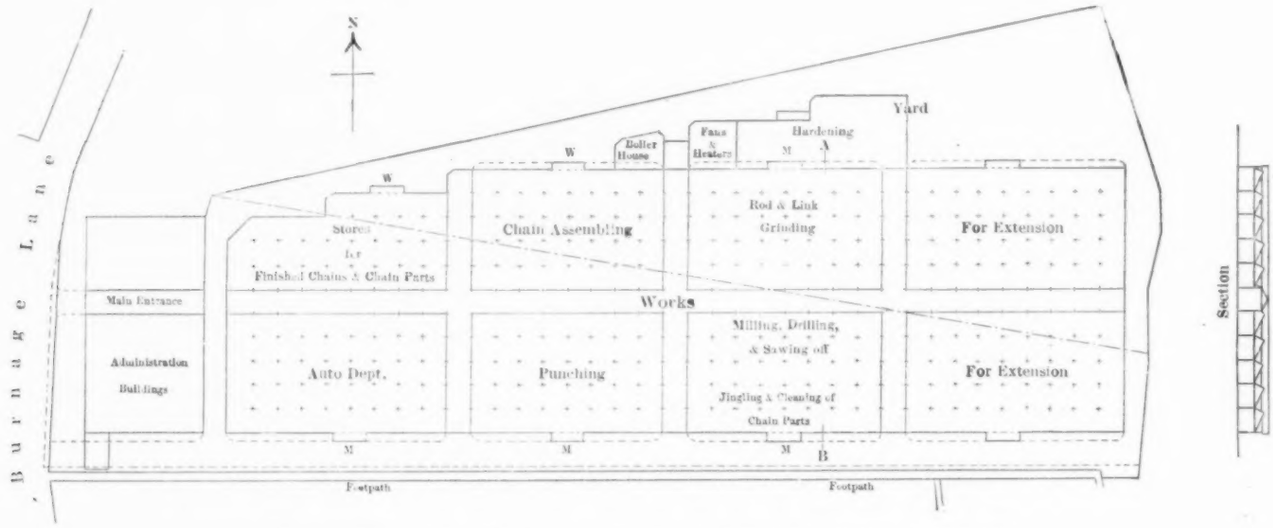


FIG. 1. GENERAL PLAN OF THE HANS RENOLD WORKS, MANCHESTER, ENGLAND

General Features

The shop is heated by an indirect system using two large heaters with their accompanying fans. This same system will be used in the hot weather of summer for cooling. The sanitary arrangements are of the best and are located in rooms conveniently situated with reference to the various shop departments. The letters *M* and *W* indicate these rooms on the general plan Fig. 1. Near these rooms are located wash rooms equipped with stationary tin copper-lined basins supplied with both hot and cold water, numbered to correspond with the numbers of the employees.

Above these wash rooms are galleries containing clothing lockers. These lockers are also numbered to correspond with the numbers of the employees. Thus an individual workman's number indicates the wash bowl that he is to use and the locker which is to contain his clothing. These galleries are in the upper part of the building, and as the floor is arranged with holes for the circulation of air, they are at all times dry and warm. This is a very essential point to care properly for the workmen's clothing in connection with a locker system. The entrances and exits from these galleries and the aisles between the lockers are so arranged that employees enter at one point and leave at another, thus avoiding all confusion during the haste of getting into and out of the factory.

A kitchen and dining-room are provided fully equipped with all necessary cooking utensils, tables, dishes, chairs, etc. All this is furnished by the company to the employees, who operate it on a cooperative plan. The diner is privileged to spend as much or as little as he likes in procuring a meal up to 8 cents, which is the cost of a full meat dinner.

Power Distribution

The plant is electrically driven, using what might be characterized as a specialized group system. About 800 horse-power are required for both power and lighting. The current is supplied by the municipal corporation at a very reasonable figure. It is alternating current, three-phase, distributed at a high voltage and transformed to 400 volts before being brought inside of the factory buildings. The racks for carrying the distributing cables are well shown in the upper part of Fig. 5. From these cables taps are taken to the various motors, also shown in Fig. 5 near the left-hand edge. These cable racks are carried over the cross gangways as well as over those running along the end of the building. Typical motor installations are shown in Figs. 4 and 5. All motors throughout the entire plant are of the same kind and of the same capacity; namely, 12 horse-power. Thus they are absolutely interchangeable in all locations. As the product of this firm is chains, we are not surprised to find that the connection between the motors and line shafting, and between various sections of the line shafting itself is by means of chain drives. This feature is also clearly seen in Figs. 4 and 5.

Countershaft Drives

Fig. 6 shows the use of a Renold silent chain for this purpose, the center distance being less than five feet. Fig. 7 shows a similar development except that the chain used is the Bush roller chain. This development is even more compact than the other, but is not quite as noiseless. Still the noise is in no way objectionable and in fact can hardly be heard.

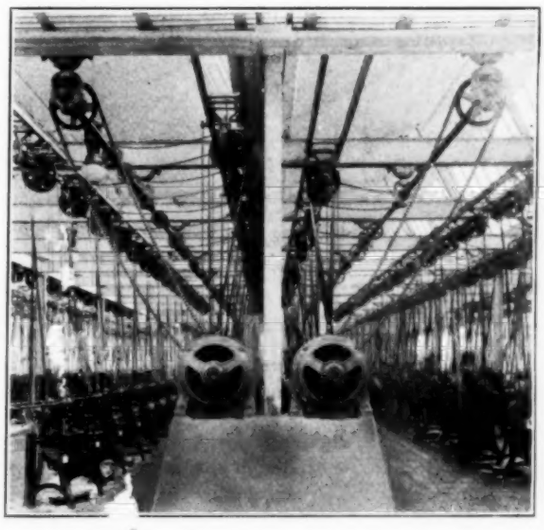
These two photographs also show the system of countershaft harness-work.

FIG. 2. VIEW OF THE HANS RENOLD WORKS FROM THE NORTH

Structural steel shapes are used and all the various members are bolted and clamped together in such a way that a minimum of labor is required to erect a given countershaft. All of this harness-work is standard in shape and size, so that individual pieces can be used at any point desired throughout the entire plant. This unique feature is extended to shelving brackets, sample boards and, in fact, to all classes of factory equipment; thus any particular piece or part of this equipment is serviceable at any point throughout the entire plant where such a piece is required. It constitutes a carefully worked out interchangeable system for the elements of the factory equipment.

FIG. 3. INTERIOR OF THE HANS RENOLD WORKS

The only department running at the time of this writing, February, 1908, is the automatic machine department. The half-tones, Figs. 4 and 5, which we have referred to for other items of interest, illustrate this department. One of the noticeable general features is the absence of overhead belts, occasioned by the use of chain drives. In this department are located 220 Brown & Sharpe automatic forming machines. In their erection a most interesting record was established. All of these machines were moved from the old factory, about five miles away, to the new one, set up and started in operation during a period of five weeks, and the labor additional to the machine operatives themselves was two laborers, one millwright and one machinist. In no case was any one machine idle for a period longer than two days. The well worked out countershaft harness-work which we have described undoubtedly played an im-



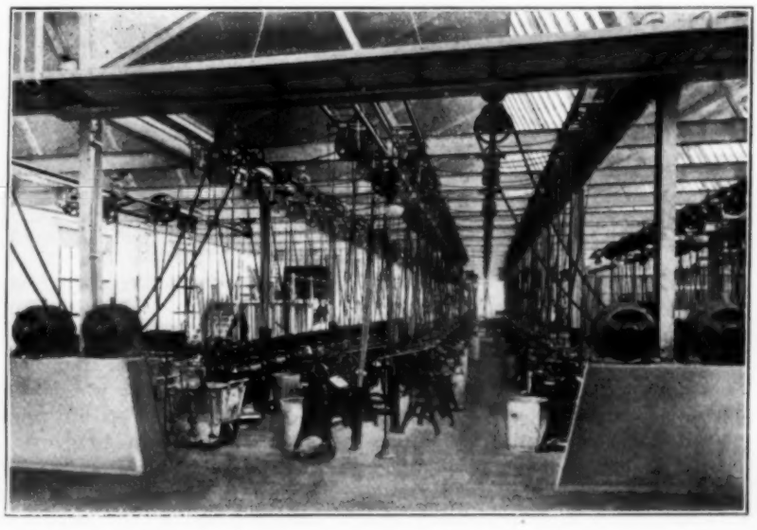


FIG. 4 THE AUTOMATIC MACHINE DEPARTMENT SHOWING LOCATION OF DRIVING MOTORS FIG. 5

portant part in the establishing of this record.

An interesting feature contributing considerably to the comfort of the foreman is the foreman's office. This is located roughly in the center of the department, has a floor raised 18 inches above the level of the factory floor and sidewalls made of glass. It is practically sound proof, so that when a foreman is inside, he is freed from distracting factory noises and yet is so situated that he has an excellent view of his entire department. Another point is that the office is not stationary, but can be moved around from place to place at will as occasion requires. Other departments are being moved as rapidly as possible, guarding against loss of production time. In general the departments are being so arranged that the number of machines can be doubled when business requires. The two large bays marked for extension on the plan of Fig. 1 are finished, but as yet are not being used.

In addition to the standard makes of machine tools which constitute a large portion of their equipment, they have built special machines for particular operations not satisfactorily performed by the others. In many such cases these special tools might be marketable because of their peculiar adaptability for some particular machine shop operation. Among these are cylindrical grinders, ring grinders, recessing machines, straightening machines, special drop presses, etc. The details of the entire plant and its equipment have been worked out with the utmost care and precision.

In the Knights Deep mine, near Johannesburg, South Africa, there were installed twelve 50-horse-power General Electric induction motors. Through an accident the mine was allowed to fill with water, the motors remaining under water for over two years. When taken out three of the motors were rewound in a local repair shop; the others were simply dried out and then soaked in oil. Contrary to expectation the insulation was found to be in excellent condition and the motors were put into immediate service, apparently uninjured.

Belt Tire Drive for Turning Wheel Journals

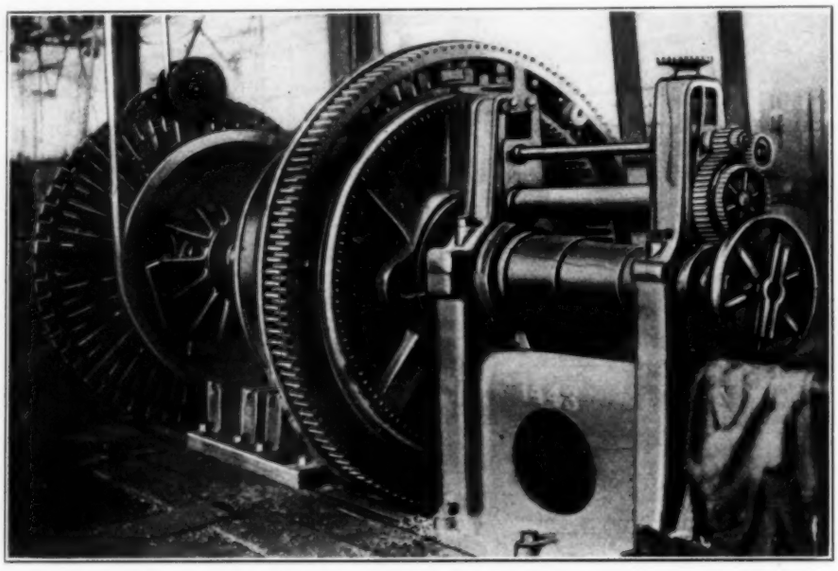
By H. W. Jacobs

Much can be done by shop foremen and skilled mechanics in increasing the usefulness, the production capacity, and the economy of output, by adapting old machines to modern requirements, thus avoiding or postponing capital outlay in expensive machinery.

An example of such a case is shown in the accompanying photograph, where an old driving-wheel lathe has been so arranged that a belt drives the driving-wheel using the tire as the driven pulley. The wheels revolve upon the centers, the face plates of the lathe remaining stationary, and the journal is turned up in the ordinary way. The wheels are of course weighted on the opposite sides from the counterbalance so as to give an even rotating effect.

Several advantages are derived from this arrangement: Since the spur gear wheel lathe drive is eliminated the chattering effect of the tool on the journal is avoided, thus making the journal absolutely true and smooth. The drivers may be revolved at a high speed for efficient action of the cutting tool instead of being limited by the ponderous slowness of the driving wheel lathe. Much less power is used as the internal friction of the large wheel lathe does not have to be overcome. In a shop equipped with one of the new powerful machines that can do a very heavy job of tire turning in an hour, the old wheel lathe need not be thrown out, but can be used especially on journal-turning work, while the big new machine is used exclusively on the work which it can most economically perform: turning tires.

This is a practical illustration of what can be done by a railroad-shop management where interest is taken in the production cost, and the photograph is of a machine so equipped at the Albuquerque, N. M., shops of the Atchison, Topeka & Santa Fé Railway, under the direction of I. C. Hicks, while master mechanic there. This railway is one of the leaders in commercial methods in railroad shops.



DRIVING WHEELS BY BELT ON TIRE

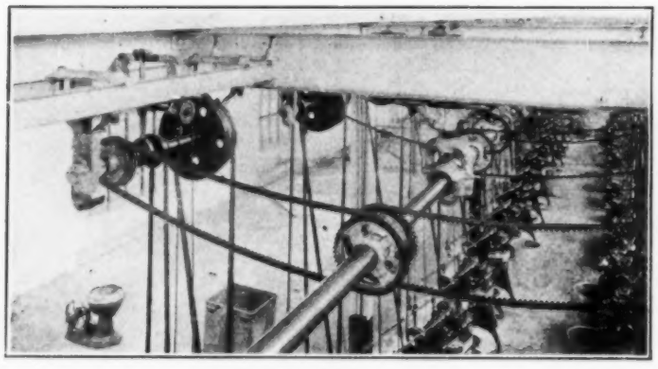


FIG. 6 CHAIN COUNTERSHAFT DRIVER

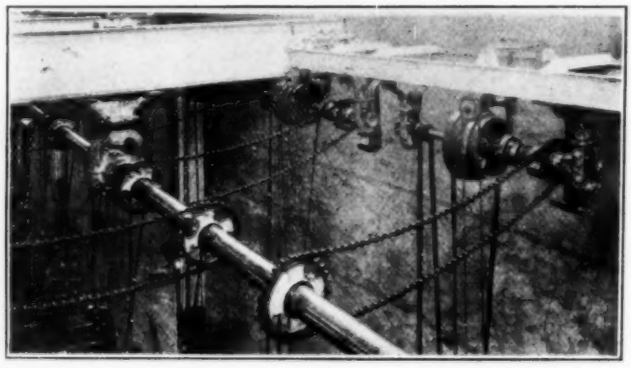


FIG. 7

A New Type of Grinding Machine

The Use of Emery Cloth Belts in a New Way to Produce Finished Surfaces at a Very Low Cost

EDITORIAL CORRESPONDENCE

Until the advent of the disk grinder we never dreamed of the amount of work that could be performed with a sheet of emery cloth when properly supported and driven at a high rate of speed, but had always considered it as a very convenient form in which to have an abrasive material for finishing work and getting into corners. The disk grinder changed our ideas in that respect and now comes another development, which, though it can be likened to the other machines in some ways, uses emery cloth in the form of endless belts and performs almost marvelous feats of grinding. Its work is not confined to any class but includes castings, forgings or almost anything that can be finished by grinding, from making drop forgings into any required shape to finishing knife handles of wood, horn or rubber and grinding both the handle and the metal mountings at the same time. This has been developed by John C. Blevney, of Newark, N. J., to the point shown herewith.

One of the plain machines is shown in Fig. 1 and consists of a stand or column, three pulleys mounted thereon as the patent sharp would say and two belts, one of leather and the other of emery cloth. The leather belt is the shorter and inside the other, which runs around the top and bottom pulleys and is driven by contact with the leather belt along the front side and around the bottom.

There are several reasons for this arrangements of belts. It allows both to be tightened to the desired tension independent of the other; it gives the emery belt an opportunity to cool off after the heat due to contact with the work; it allows any desired cushion to be obtained behind the grinding belt and the cost is less for the leather belt than as though it was made the full length.

The tension on the belts is kept uniform by the weights at the back and it is also possible to give either of the upper pulley shafts a slight inclination to offset any tendency of the belt to run to one side. The belts run past a support seen behind the belt and just above the table so that by pressing any piece of work against the belt at that point a flat surface is produced without any skill on the operator's part. Where this is to be square or at a given angle with another surface it is placed on the table or in any sort of fixture desired. Regular buffing can be done by removing the table and using the curved part of the belt just below the supporting plate and this has the advantage over most buffing wheels of having the emery surface thoroughly cushioned.

It will be noticed that the leather belt has ridges across its face as can be seen at the top of the middle pulley. These are to give what might be called grinding

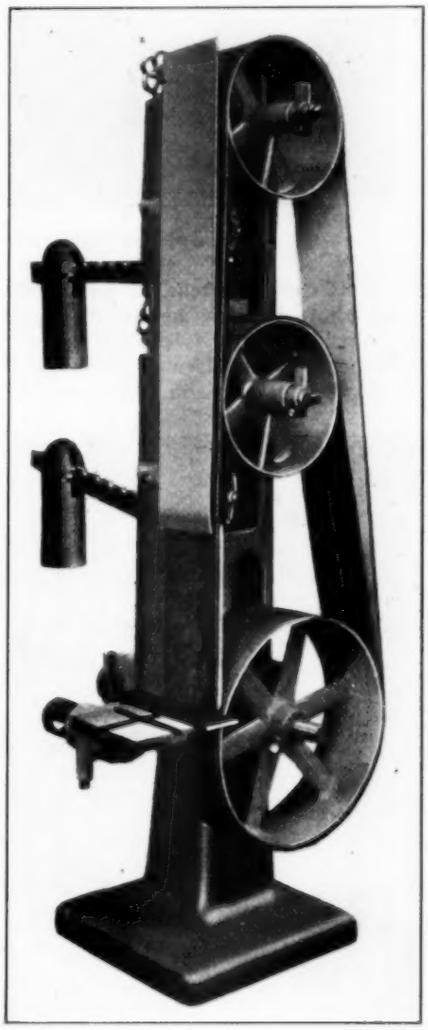


FIG. 1. THE PLAIN EMERY BELT GRINDER

points and cushions between to allow room for the chips to get out of the way without rolling over and over and scratching the work before they escape, which is one reason for the grooves in a disk grinder. While this belt is best for fibrous material where large chips are had, the belt shown in Fig. 2 is better for metal. This is perforated and then has large countersunk holes in the outside as can be seen on top of the middle pulley. These perforations and depressions are staggered so that all portions of the width of the belt are alternately supported by the solid leather and then cushioned. The difference in the length of the belts force the portions coming together to change position each revolution so that every part of the surface receives equal and maximum wear, getting all the work possible out of the belt.

Steel belts, perforated in a similar manner to the leather belting, are also used for work which does not require the cushioning to the same extent as that afforded by the leather.

The emery belting is made up from rolls of emery cloth which can be bought from any large dealer and cut into the desired lengths and widths. The emery is cleaned from one end for a lap and a joint made with glue in the ordinary way so that the cost of the abrasive material is low and the waste is very little, while the entire surface is used up in doing work.

The first thought is that a belt of emery cloth will be torn by a rough point on a casting or forging, and regular grinders and buffers have been hired to see if this would be the case. But they have never been able to get a hole in a belt until it wore down from constant use; then the hole would be worn and not torn. The whole secret of the matter is that it is practically impossible to get the work against the belt hard enough to do any damage before the sharp corner has been ground away as the belt travels 7000 feet a minute.

The idea of running an emery belt over a support and grinding flat work by pressing against it is not new, as that plan is being used to polish the heads on cap-screws and bolts, but the use of the leather belt and the perforations to still farther add to the cushioning effect is different, and the results are both surprising and gratifying. That the cushioning is of real benefit is shown by the grinding of such materials as hard rubber or the softer metals which clog an emery wheel and usually glaze the materials, while with this method the grinding seems to be about as clean as with iron or steel.

In addition to plain surface grinding, such as the bottom of flatirons, the sides of sledge hammers and similar work, Mr. Blevney had adapted the machine to many other forms of work, many of them being

done automatically. An example of this is shown in Fig. 2.

This grinds the curved face of the claw of a carpenter's hammer without any guiding on the part of the operator. It is the same machine as in Fig. 1, with the table removed and the attachment shown put into place. This is driven by a belt from a pulley on the main shaft through a worm at the bottom and the bevel gears at the top. This gives the proper motion to the hammer-head and at the same time moves it across the belt to insure even wear, gives a better surface to the hammer.

The hammer-head is held in the fixture shown at the left on the base, one being inserted while the other is being ground, and when the grinding is finished the operator merely pulls out one fixture and slips the next one into place while he changes the hammer-heads. Every hammer is exactly alike, and the grinding is done in a very short time.

The sides of the same hammer are ground in the special machine shown in Fig. 3, although this machine can be easily adapted to a large variety of double-side work. Here the emery belts run horizontally and on edge as seen in the foreground. The hammer-head to be ground is just about to be lowered between the belts, and is back of the head which acts as a form at the front of the machine. When this frame is lowered so as to come between the grinding belts, the form at the front comes between the curved plates, and as the hammer is pushed forward, these move the belts sideways so as to grind the hammer to conform to the pattern used. The belts are driven by the quarter-turn belts on top, allow any adjustment desired, and the moving parts carrying the hammer-heads are counterweighted so as to move easily under the operator's hand.

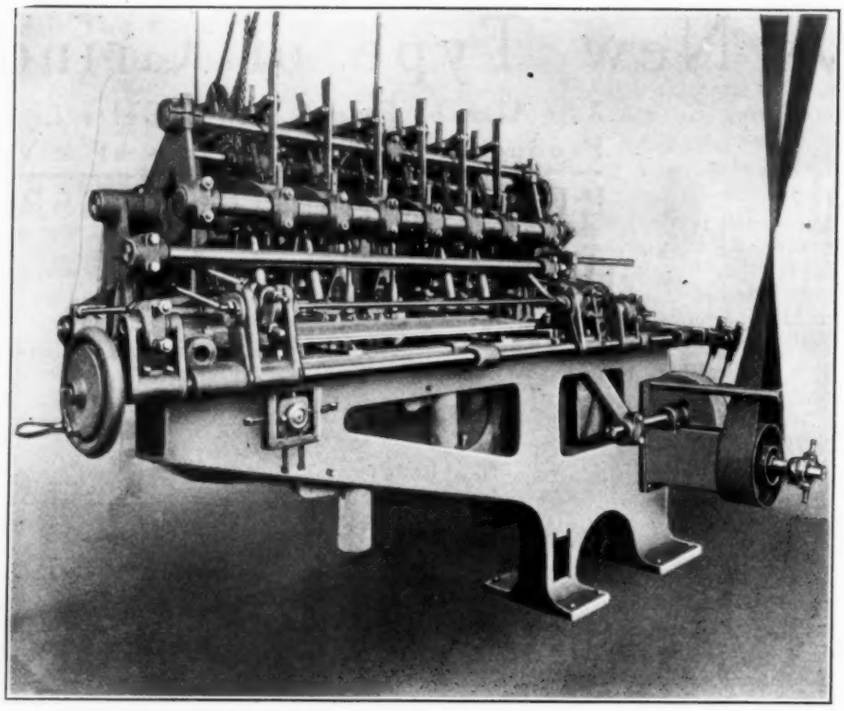


FIG. 4. MACHINE FOR GRINDING THE ENDS OF SPECIAL DROP FORGINGS

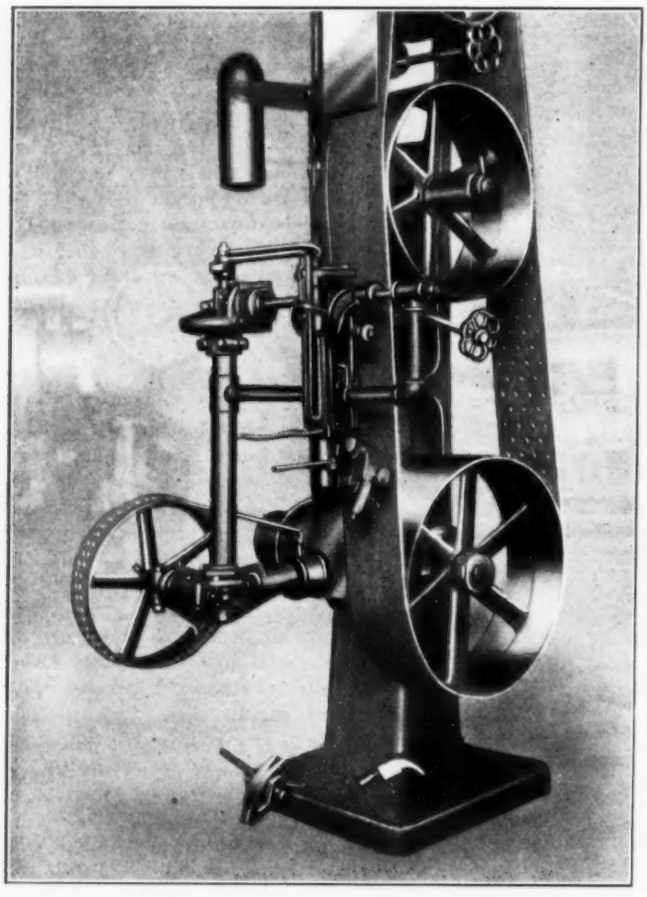


FIG. 2. ATTACHMENT FOR GRINDING HAMMER HEADS

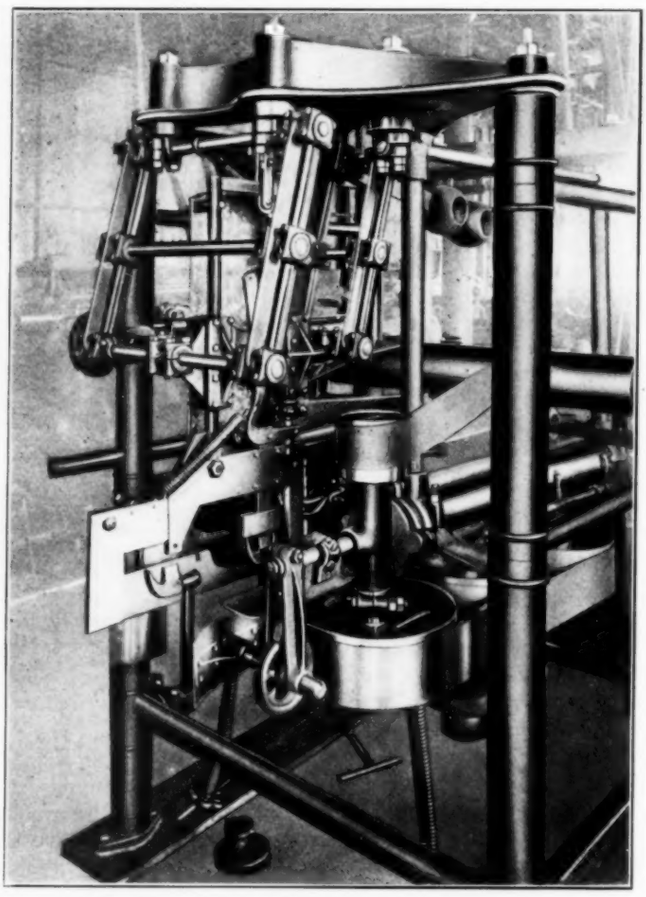


FIG. 3. GRINDING THE SIDES OF THE CLAW HEAD

One passage between the belts finishes the sides of a hammer unless it happens to be a bad forging.

Another machine is shown in Fig. 4 which grinds the ends of special drop forgings. This has six spindles, each with a simple chuck for holding the forgings and each spindle is revolved slowly by the shaft near the top carrying six worms. The whole machine is driven from the pulley at the right, the other end of this carrying the driving pulley for the leather and emery belts, which run horizontally on the other side of the machine. The worm wheel near the main driving belt carries a rope pulley which drives the worm-shaft by passing the rope over idlers. A crank on this same shaft drives the rock-shaft in front, the wheel at the left being for turning this by hand into any desired position.

This rock-shaft swings the whole upper framework carrying the worm-shaft and also, by the cranks at each end which move it across the emery belt, gives a compound movement which can be made to produce about any shape desired. The two middle spindles are shown loaded, the latches shown in Fig. 5 are lifted so that the work spindle can be swung into a vertical position, when the worm at the top will engage the worm wheel and the spindle revolve at the same time moving across the belt and swinging to any angle. In this particular case it gives a perfectly flat end except for a slight rounding at the edge which was desired.

It will be noticed that the bed of this machine is very narrow and appears to have a great overhang, but the whole work head, if it can be so called, is counterweighted by a rope and weight so that the whole head is practically floating and the weight does not come on the bed at all. This machine takes special forgings right from the trimming dies, after the drop hammer flash has been cut off and finishes the ends to the desired shape at the rate of 400 an hour.

The bearing at the left of the bed carries the outer belt-pulley shaft and, as will be seen, can be adjusted very easily in any direction. The worms shown in detail in Fig. 5 are cast in halves and bolted together on the worm-shaft and the worm wheels themselves are cast in a two-part flask, which accounts for their being tapered instead of the usual shape. While the tooth action in such a case might be a bugbear to a gear-tooth expert, it must be remembered that this is not precision machinery, and that it is very easy to make some classes of machinery too well. The pressure of the work on the grinding belt is regulated by the tension of the spring pulling down the lever which centers the work spindle when in the grinding position.

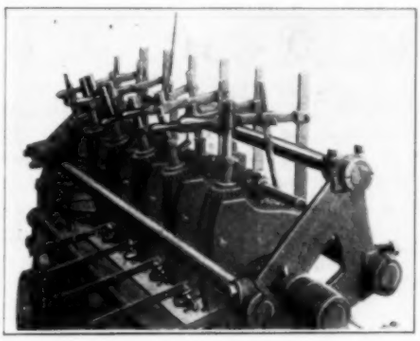


FIG. 5. DETAILS OF THE DRIVING MECHANISM

Altogether these are very interesting machines and the grinding principle which they represent is sure to attract widespread attention. F. H. C.

The fourth International Automobile Exposition is to be held in Budapest, Hungary, during the month of May, 1908. This exposition will possess especial interest to American automobile and agricultural-machinery exporters. The president of the proposed exposition particularly requests that American manufacturers take part and exhibit any automobile agricultural machinery that they may be able to supply to progressive farmers in Hungary.

Attachment for Grinding Automobile Cylinders

The Thompson Grinder Company, Springfield, Ohio, is building a new attachment for its universal grinders which is finding favor in shops where automobile cylinders are part of the product.

A special grinding head is put on the machine, which has plenty of metal to insure stiffness and which supports the hardened tool-steel spindle close up to the wheel. The spindle bearings are adjustable so as to take up all wear and insure the wheel running true and without any tendency to jump in the bearing. A cotton belt is used for driving the spindle and is kept tight by the idler shown.

The cylinder to be ground is held in the hollow chuck or spindle shown at the left of Fig. 1, being supported by the flange which fastens it to the crank case of the engine bolted to the larger flange shown in front of the cylinder. This larger flange fits into the end of the hollow spindle as shown in Fig. 2, and is held in place by the four bolts shown. This method of holding the cylinder removes all chances of springing as would be the case in clamping it between chuck jaws and should leave a very true bore when removed from the chuck.

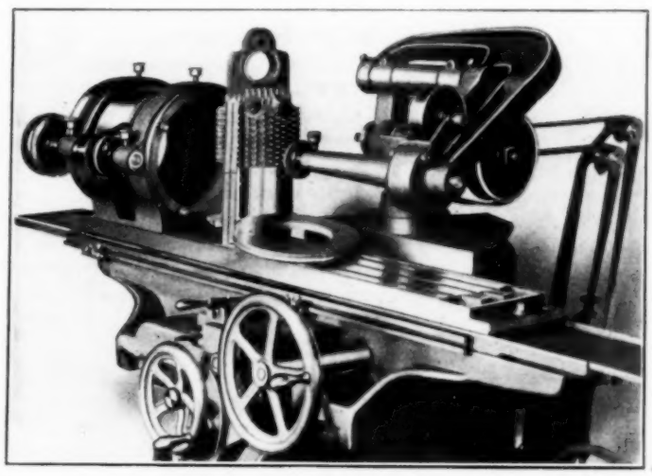


FIG. 1. THE GRINDER AND THE WORK

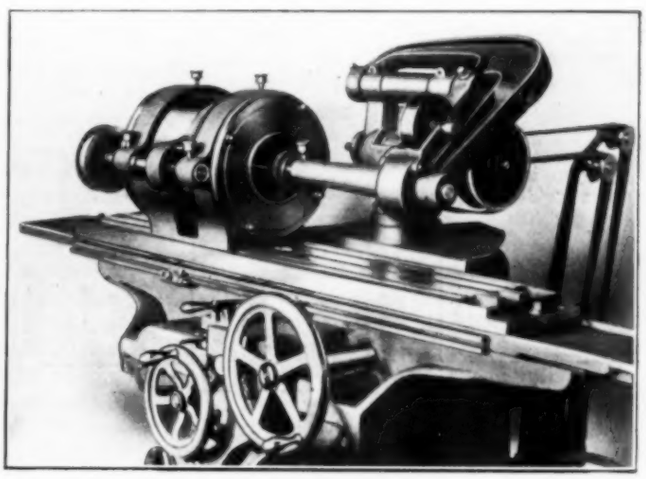


FIG. 2. GRINDING THE CYLINDER

The hollow spindle runs in very large bearings which insure the cylinders being driven in a true circle, and are large enough to absorb vibration. The hole in the spindle is 10 inches in diameter, and the cylinder being ground is 5½ x 11 inches. The work is driven by the gear and pinion shown.

Provisions are made for using a stream of water with this attachment if desired, as is the case with the regular grinder. They also fit this attachment for grinding pistons, piston rings, crank-shafts and other similar grinding so that the machine can be kept continually occupied in any shop doing this class of work.

The Time Required for Machine Work—I

Examples of Automatic Screw-machine Work That Help in Estimating or in Selecting the Best Types of Machines

BY FRED H. COLVIN

The finishing of cylindrical work by grinding is subject to so many misunderstandings that it seems best to first try and clear away some of these before giving any examples of the work.

I cannot do better in this respect than to quote a paragraph from a recent letter of Charles H. Norton who has done much to promote grinding as an economical process. He says:

"The grinding machine in itself, without the aid of the lathe man, is not an economy and our grinding machine, being made especially with a view to saving lathe work, is more expensive than the old line of grinding machines have been when the aim was simply to grind the surface after it had been accurately turned. We cannot separate the grinding from the turning and show economy. We therefore feel diffident about publishing grinding times without each time publishing with it a very long article telling how to turn work. Where we have been able to get our friends to turn their work in an economical way suitable for grinding with our machines we have been able to show great economy."

In the examples shown with this the turning time is given whenever possible as it is on the total turning and grinding time that the real economy depends. In fact the economy of the process comes from a saving in the turning and unless this is made, finishing by grinding may become an expense instead of an economy. True it gives an accuracy in roundness that is ahead of any turning process, but it is not economy to have this an additional expense when it can be had at the same or at a lower cost than turning in the old way.

So the first step in using a grinder economically is to learn how to turn work that is to be finished in that way. We must forget the old way of turning pieces with a smoothing cut to within 0.01 inch or less, and then finishing by grinding with a light grinder that would not stand any kind of a cut without springing. This was when finishing by grinding was an expense that was endured because of the greater accuracy. But this is no longer necessary and cannot be afforded if we are to compete with others who are taking advantage of the newer methods and heavier grinding machines that are now on the market.

It seems almost a heresy to leave work for grinding so rough that it looks more like a broach than a piece to be ground and even rougher than we formerly turned for a roughing cut because our lathes would not stand it, but this is the only way to get economical results with the heavy grinding machines of today. Shut your eyes to all the former notions, turn the stock to within from 1/64 to 3/64 inch and with a feed of 1/16 to ⅛ of an inch per revolution, practically 8 or a 16 threads per inch, and you are on the right road toward economical grinding.

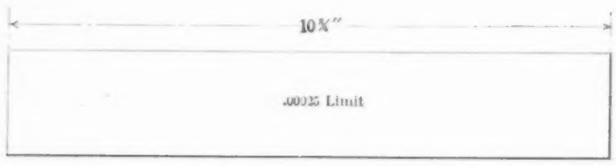


FIG. 1

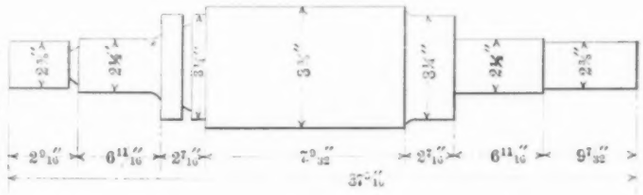


FIG. 4

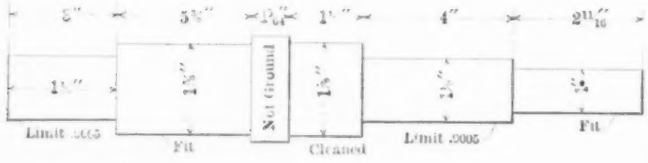


FIG. 2

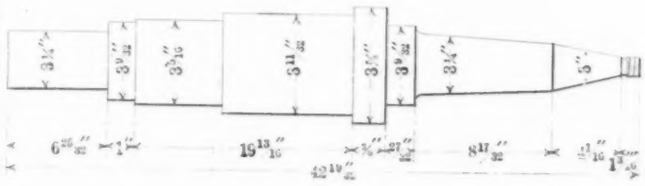


FIG. 5

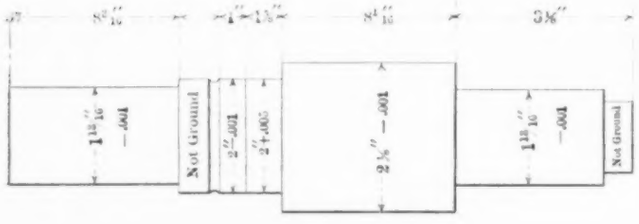


FIG. 3

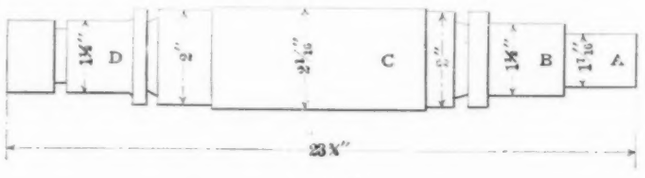


FIG. 6

EXAMPLES OF CYLINDRICAL GRINDING

So that if the time given in the following examples seems short, don't look wise and think it can't be done until you try it with the proper preliminary turning and remember that the turning time must be much less than if you finished entirely in the lathe, or there is no advantage in the grinding method except the greater accuracy obtained.

The first example is plain grinding from cold-rolled steel stock where only 0.018 inch was removed so that no turning was necessary. The wheel used was a 24-inch combination grit of L grade and 15 pieces were ground in 44 minutes.

The next example was turned to closer limits than is desirable for economy and

as the turning time is not known we cannot compare the total cost of finishing with the other pieces. The limits of accuracy are very close on some parts as can be seen from the sketch. The material is 0.30 carbon steel, stock removed 0.018 inch, the wheel 24-inch combination L, as before and 12 pieces were ground in 150 minutes, or 12½ minutes each, but a single piece is not as good a test as the average of a lot.

A similar piece is shown in Fig. 3, which is also a low-carbon steel. The stock removed was only 0.015 inch in this case. The same wheel is used. The limit on bearings was 0.0005 inch only; 25 pieces were ground in 505 minutes or 20 1/5 minutes each as an average.

The rest of the examples show the turning time, which it will be seen is very low indeed and shows where a decided economy can be effected over usual practice.

Fig. 4 was rough turned in one cut (the sketches not being to scale is a little confusing in this, but the diameters given show that this is easily possible) leaving 3/64 inch for grinding. The turning speed was 60 feet per minute with a feed of 1/16 inch per revolution and the turning time was only 20 minutes. Then the ends were squared up, oil grooves cut and shoulders finished, which took 50 minutes more. The grinding averaged from 30 to 40 minutes, but a single piece of this kind has been done in 18 minutes. The total time per piece was 100 to 110 minutes.

Fig. 5 is another example of the same kind which was rough turned in one cut so as to leave 3/64 inch of stock for fininshing, being turned at 65 feet per minute with a feed of ⅛ inch per revolution. Turning time was 15 minutes. The squaring up of the ends, finishing of shoulders and cutting of thread took 45 minutes. The grinding averaged to take 30 to 40 minutes, although a single piece has been done in 14 minutes. The total time was 90 to 1000 minutes.

The last example is somewhat similar to Fig. 4, but is shorter so that it takes less time to go over it. This was rough turned in two cuts, leaving only 1/32 to grind. Turning time 20 minutes. Ends were squared, shoulders finished and oil grooves cut in 25 minutes. Grinding time 18 to 22 minutes. Here the parts *A* and *C* were ground to limits of 0.0005 inch and *B* and *D* to 0.001 inch, while all lengths are to gage. The total time on piece is from 60 to 70 minutes.

In all grinding it is necessary to use the wheel best suited to the work to get the best results and in this there seems no better way than to tell the wheel-maker just what the work is.

The examples shown with this were furnished by the Norton Grinding Company, Worcester, Mass.

The machinery exports (not including locomotives) from the United States to Cuba during 1907 ran to $2,619,237.

The Automatic vs. the Hand Lathe

By W. Conrad

There has recently been read in England before different societies of engineers, a paper entitled "Modern Machinery, and its Future Development," an outline of which appeared on page 494 of American Machinist, Vol. 30, Part 2.

In this paper the author, H. I. Brackenbury, tries to show by means of curves and examples that it is cheaper to produce large work on the hand machine than on automatics. He contends that the automatic has been over-developed, and that the future tendency will be to have plain, powerful, non-automatic machines for roughing out work, and the finishing be done on grinding machines.

Until recently the grinding machine has been considered somewhat of a luxury; but even at its present state of utility, I do not think it is economical to finish every class of work on the grinding machine. Not that the actual cost of grinding is too high, but one has to consider that sufficient grinding machines would have to be kept to comply with the increased demand. A certain amount of time would be lost in taking the work from one machine to another, besides the extra setting up to be done in the grinding machine. Therefore I argue that, if a satisfactory finish for a certain class of work can be obtained in the hand machine or the automatic, there is no advantage to be gained by finishing that work in the grinding machine.

Now to consider whether the automatic is a money saver or not. When picking out work for the automatic, there are several points to be taken into consideration. The chief of these are:

1. The amount of machining to be done on the piece; 2. The quantity of pieces to be produced at one time; 3. The probable time required to change the machine from one job to another; 4. What special tools, if any, will be required to do the work to the best advantage? 5. Will these special tools come in for the same job at a future date, or is the shape of the piece of work likely to be changed? 6. Is the design sufficiently standard that a quantity of the pieces could be made at one time for stock?

With regard to the first point, there is probably more advantage to be gained on the automatic where the shape of the piece of work to be machined is such that the total time required for machining is rather long. For example, suppose on a large piece of work the total time for machining is only a few minutes; then providing the quantity is not great, it would be cheaper to have these done on a hand lathe, and keep the automatic for more profitable work. A good many people have different opinions about what is the least quantity of pieces that can be made with advantage on an automatic. This of course depends a good deal on the amount of machining to be done on the piece. For example, either of the pieces shown in Figs. 1 to 7 could be profitably handled on the automatic even if only 30 or 40 were to be made. Of course smaller pieces would require larger quantities to pay; but even on the simplest pieces, I have found that it pays to make any quantity taking 100 as the minimum.

The next point mentioned also depends on the size and amount of machining on each piece. With an experienced operator it ought not to take long. When he sees that one machine has nearly finished making the required quantity, he should look up the next job for the machine and get all the required tools together. As soon as the operator receives an order or notification to make a quantity of a certain piece, he should look up his tools at once, see what specials are required, and get them made at once so as to have them ready when he comes to set the piece up on the machine. If the design of the piece is likely to remain unchanged for some considerable time, it is best to have the tools made in the best manner, so as to save as much time as possible; but if it is thought to be only a temporary shape, or there is any doubt about its being changed, then it is justifiable to make the tools as cheaply as possible, sacrificing a little time on each piece rather than making expensive tools. I will now endeavor to show how, in my opinion, automatics can and do save money, provided they are set up and operated properly.

Comparing Operations

To commence with, take the comparative operations to be gone through in setting up a hand machine and an automatic screw machine. The operations of putting in the chuck, chuck fingers and bar stock are about the same in either case. This is also true in regard to placing and adjusting the tools in turret and on cross slide. Now comes a difference; on hand machines there are adjustable stops to set for each tool in the turret and on the cross slide; on the automatic there are adjustable cams to set, which should not take the operator any longer than to set the stops on the hand machine. Now comes the advantage of the automatic over the hand machine. While the operator of the automatics sets up one machine, all his other machines are going on working; assuming he has six machines under his supervision, only one-sixth of his output is stopped temporarily, while in the case of the hand-machine operator the whole of his output is stopped while setting up his machine. Then again, in automatic machines on any class of work, the element we call human nature in the operators, by which we mean all the little things which come up, distracting the attention of the operator, does not decrease the out-

put of the machines, for the obvious reason that the automatic machine is in active operation continually, losing no time from actual cutting if the operator goes away and leaves his machines for a few minutes.

An automatic operated by a medium-priced man can do high-class, accurate work that on an ordinary engine lathe would require a fine mechanic receiving the highest pay; and the automatic operator can care for six machines, which are equal to more than twice that number of high-priced men, at a less cost than one such man.

What Actual Figures Show

To take actual figures from working conditions, let me refer again to Figs. 1 to 7. The piece shown on Fig. 1 is made from 0.20 carbon stock. Notice the amount of work on this piece, the time for making on the automatic being 60 minutes. Take the wage of a well experienced operator to be 30 cents per hour, on the understanding that he can operate five machines. Suppose he has a boy to help him who would receive 15 cents per hour; the actual labor cost for running five machines would be 45 cents per hour, or 9 cents per hour per machine. Now take the hand machine and assume the operator to receive the same wage as the automatic operator (30 cents per hour); can you imagine him making this piece for 9 cents, or in 18 minutes? Thus for a hand-machine operator to compete with an automatic operator he has got to produce the same work in three-tenths of the time it takes to do it on the automatic.

Following are the times for producing the pieces shown; also the time the hand-machine operator would have to make them in to compete with the automatic:

Fig.	Actual automatic time. Min.	Necessary hand machine time to compete with automatic. Min.
1	60	18
2	40	12
3	45	13
4	40	12
5	15	4
6	25	7
7	35	9

These times are taken from actual working conditions of Cleveland automatics, and are not merely catalog figures. It will be noticed that the necessary hand-machine time in each case is three-tenths of the automatic time; I think I am not saying too much in stating that it is practically impossible to produce these pieces in much less time than that given for the automatics. In each case also these times are for finished pieces; were these to be ground, the times would be somewhat lower, as no finishing cuts need be taken. From the above we can see that the hand-machine operator has got to do some wonderfully rapid work to beat the automatic. Also a man could not operate as large a machine as would be required to produce these pieces as easily and quickly as an automatic, for all the working parts would be heavy and cumbersome, making it somewhat of a strain on the operator every time he moved his slides. Combinations can also be worked on the automatic, such as forming and drilling at the same time, or other operations arranged so as to finish two simultaneously. On the present-day large automatics, bars weighing up to 1000 pounds can be handled with almost as much ease as small bars weighing only 10 or 20 pounds. Where one man can look after and run five machines, the duties of the manager become lighter; if hand machines were employed, it would probably take more than ten men to do the same work of these five automatics, and, consequently, the manager or superintendent would have to look after more men.

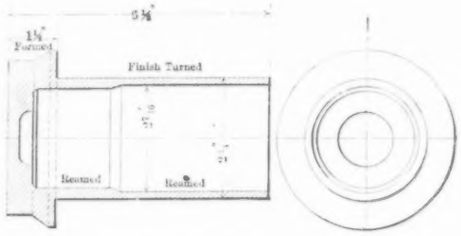


FIG. 1 Material .20 Carbon Stock

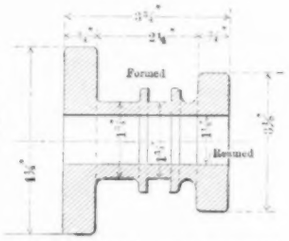


FIG. 4 Material .50 Carbon Stock

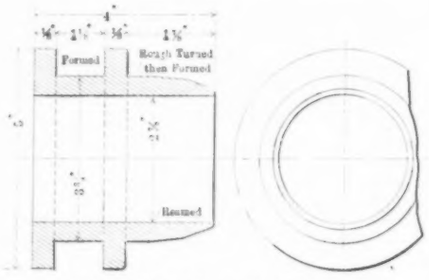


FIG. 2 Material .30 Carbon Stock

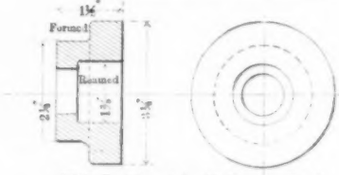


FIG. 5 Material .20 Carbon Stock

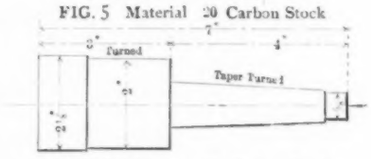


FIG. 6 Material .20 Carbon Stock

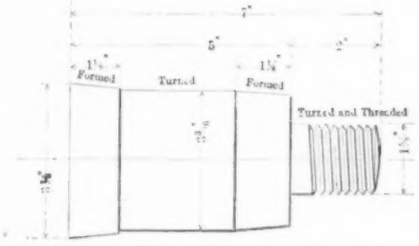


FIG. 3 Material .30 Carbon Stock

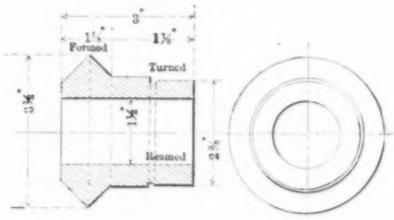


FIG. 7 Material .20 Carbon Stock

WORK FOR THE AUTOMATIC MACHINE

What Figures Show

Now for the sake of argument let us compare prices of the automatics and the hand machines. A 4¼-inch automatic would cost about $1750; allowing, say, $250 for special tools (which is probably more than would be required), a batch of six machines would cost $12,000. Six hand machines with complete sets of tools to handle 4¼-inch bars would cost about the same price as the automatics. The labor cost for running the six automatics would be $4.50 per day (man, $3; boy, $1.50). Assuming 300 working days in a year, total labor cost for one year would be $1350. Six men for hand machines, each earning, say, $3 per day, would cost $5400 for a year's work. Giving the hand machine the benefit of the doubt, and assuming that it will turn out as much work as an automatic (which is very doubtful), the gain in labor of the automatic would be $4050. Therefore, in three years a batch of six machines would pay for themselves. But on the information of managers of large concerns, besides personal observations, I consider that a group of automatics under a well experienced operator are worth at least twice the same number of hand machines. We could even allow $500 off the saving of the automatic for extra expenses and still have a good margin of profit.

I think we have here sufficient evidence of the money-saving qualities of the automatic. I can only say again, in conclusion, that these particulars are *not* based on catalog figures, but are taken from actual facts. With the expenditure of a certain amount of forethought, I think it can be arranged for the automatics to be kept fairly busy all the year round, so as to avoid the periods of having non-productive capital. To withdraw the automatic from the field of manufacture at this stage would be like taking a telephone out of a business house and going back to the old messenger system, or doing away with the typewriter to use pen and ink.

A New Car-wheel Chill

For many years it has been customary to cast the best car wheels in what is known as a contracting chill, and the one in most successful use has been what is known as the Barr patent. This makes an expensive mold, as after the chill has been cast it must be bored to the proper diameter of the wheel and must then be sawed on a special machine with a large number of slots, averaging 98 slots for a 33-inch wheel. This sawing requires from seven to ten days, and is not only expensive, but also often occasions considerable delay. Each floor of the foundry is equipped with about 25 of these chills, as it requires one chill to each car wheel per day, and as the capacity of car-wheel foundries varies from 150 to 1000 wheels per day, this means an extremely large investment in these chills. Then, too, the life of these chills is very often quite short, especially if the iron is soft enough to be easily machined.

The accompanying illustration shows a new chill which has been invented by B. M. Carr, superintendent of machinery at the Dickson Car Wheel Company, Houston, Texas. This consists of a series of segments made with dovetail ends and placed together to form a circle with a small facing strip on the face for the purpose of forming the slot, as well as to relieve the holes of gas. Then an iron ring is cast around this dovetail, which holds all the segments together into a solid mold.

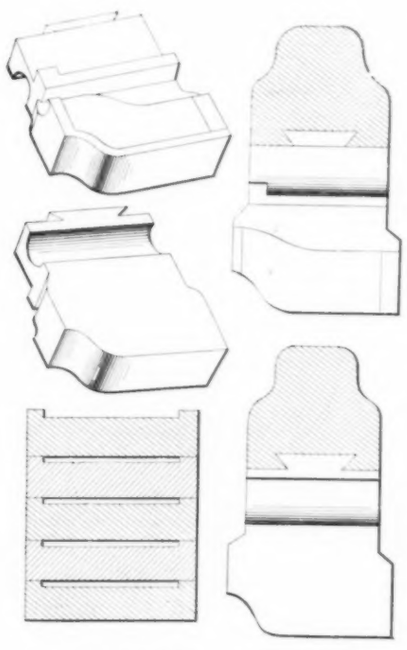


FIG. 1. BUILDING UP THE CHILL

In this way it is possible to reduce the slot to 1/64 or 1/32 inch, while with the sawed slots it is almost necessary to make them at least 3/32 inch on account of the thickness of the saws. As the only machine work necessary on this form of chill is to bore them out to the correct diameter of the wheel, it reduces both the delay and the cost of each mold, and seems to be advantageous in every way.

Mr. Carr informs us that this is no longer an experiment, but that these chills are being used daily in making 700-pound wheels, and that there is a great saving in both time and money. They are also said to make smoother wheels so that grinding will be unnecessary, and to retain their shape much better than the other form of chill.

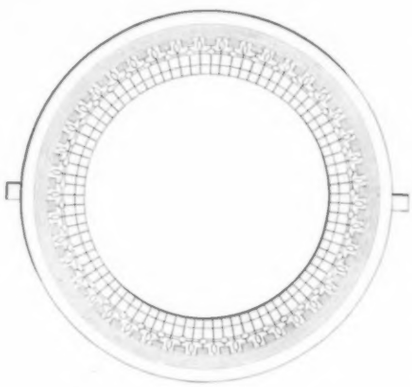


FIG. 2. THE COMPLETED MOLD

Burning a New Flange on a Double-motor Cylinder

By David Whyte

Gasolene-engine cylinders frequently break off the flange. Many repair men, thinking it is not possible to fix them, order a new cylinder at a great expense, while if a new flange were burned on similar to the job described below, a great saving would be made in machine work and the cylinder be made as serviceable as a new one.

This particular job on which we burned a flange was a double cylinder of 5-inch bore. When brought into the shop it had scarcely any flange left. As the shock it had received broke the flange at every bolt hole, the following course was pursued in repairing it.

In the first place the cylinder was sent into the machine shop to have the remaining pieces of flange cut off. While that was being done, two 5-inch cores were made to insert in the cylinder bores, as shown at *A A*, Fig. 2. The pattern-maker than cut a flange as shown in Fig. 1; this flange was made to slip over the outside of the cylinder body and was ¼ inch thicker than the original one, to allow for machining.

This being done, we secured a flask large enough to take the cylinder and rammed it up, as shown in Fig. 2, with the flange *B* in position making the parting at the bottom of the flange and keeping the parting of the flask an inch apart, as shown at *C*, so as to allow the iron to flow off until "the burn took" (to use a molder's phrase). Of course this can easily be felt by using an iron rod to feel of—the surface exposed to the molten metal until it has softened enough to fuse with the liquid iron poured in to form the flange.

After ramming up the top and parting it in the ordinary way, a hole was cut in the cope as shown at *D D*, the shape of which was such as to allow the rod to be used, in feeling of the metal in the cylinder. Thus we knew when it fused with the molten iron. Flowers were then cut as shown by the dotted lines at *E E*, Fig. 3.

The mold, now being completed, was put in the oven and dried. It was taken out at casting time and put into a hole already dug for it and provided with the necessary trenches to receive the metal that ran through the flowers. The top being weighted down, we then poured the metal in by using ladles holding 100 pounds of iron. Three of these were required, one after the other, to fuse the casting all around. The flowers were stopped up one at a time as fast as the part of the casting opposite them became fused.

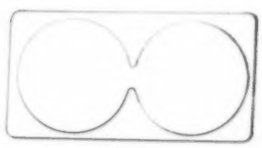


FIG. 1

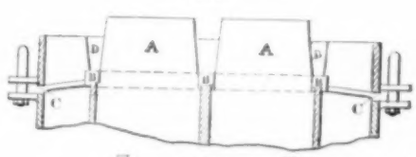


FIG. 2

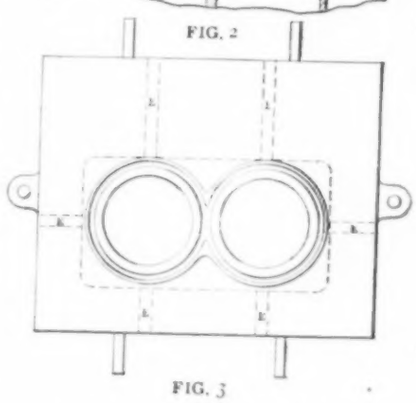


FIG. 3

MOLD FOR BURNING ON FLANGES

The next morning the cylinder was sent into the machine shop and had the flange machined and drilled. The entrance of the bores was tapered off in the ordinary way; this took away all marks of the burning. It was then assembled with the engine on the automobile and is still running quite as good as new.

Molding Drums for Hoisting Engines

The Sweeps, Bars, Anchors, Spiders, Core Boxes, Etc., Necessary to Sweep and Build the Molds in Green Sand or Loam

BY JOSEPH F. HART

Three types of drums used on hoisting engines are shown by Figs. 1, 4 and 10. The other figures give the rigging for molding them.

Fig. 1 is the most common style and comes in sizes up to those having flanges four feet in diameter with a body twenty-four inches across by five feet long.

The smaller sizes being regular are made from standard patterns and need no comment here. The larger ones are apt to come any old size and require the carrying in stock of a number of different sizes of flange and friction patterns and a short piece of the different sizes of body patterns which can be drawn up to any length. Extra heavy flanges and odd diameters of body are made by lagging up regular patterns.

The overhang at *K*, Fig. 1, is made with dry sand cores, and the ring *A* is formed in the pattern except when made in green sand; then a short section of dry sand core is placed in front of the gates which enter two places at point *B*.

Even the larger sizes of this type of drum can be made in green sand, but there is a greater risk of loss and the casting is bound to weigh more, so as a general rule they are molded in dry sand. In either case the only feature of interest is the method of making the cheek part of the mold.

These castings are made in square flasks the cheek portions of which are made of three depths, twelve, six and three inches, so that almost any desired length of pattern can be accommodated. The bottom pieces of the cheek have a strong internal flange as in Fig. 2 on which are placed four arbors similar to Fig. 3, the bars *E* to which gaggers are hung coming over the bottom flange to within a few inches of the body pattern at *C*. These arbors are not fastened in any way, but simply rest on the flange in the box and tumble out when the casting is removed from the mold.

By Fig. 4 is shown a drum which is made in sizes from eight inches in diameter and six inches in length up to a diameter of twelve feet with a length of nine feet. It is made with or without the friction shown here.

In one shop I worked in we made this type of drum without the friction in sizes up to two feet diameter and 36 inches long, core and all in green sand, but it is a rather slow job and requires a pretty good molder to be any way sure of good results.

The larger sizes of this kind of drum vary so much that they are generally swept up in loam; Figs. 5, 6 and 8 show the sweeps used and Fig. 9 gives an idea of the arm and hub patterns and the two core plates.

Fig. 5 is a peculiar looking sweep and could not be removed from the mold were

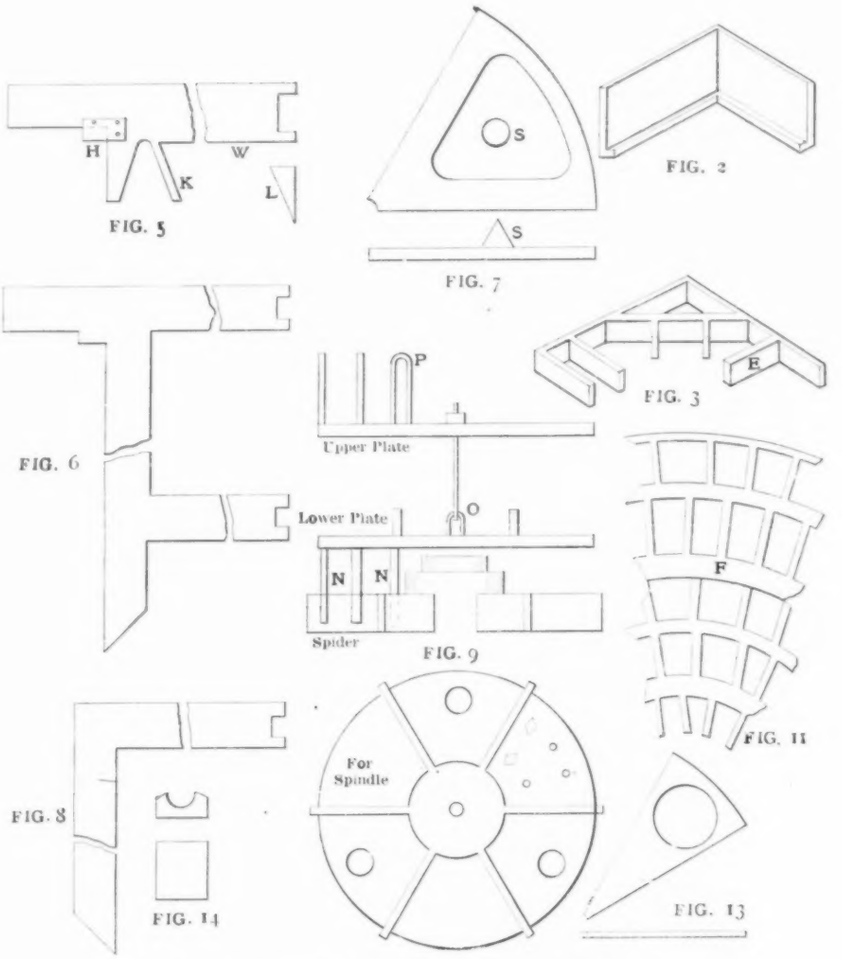


FIG. 5 FIG. 7 FIG. 2 FIG. 3 FIG. 6 FIG. 9 FIG. 11 FIG. 8 FIG. 14 FIG. 13

SWEEPS AND RIGGING FOR MOLDING DRUMS

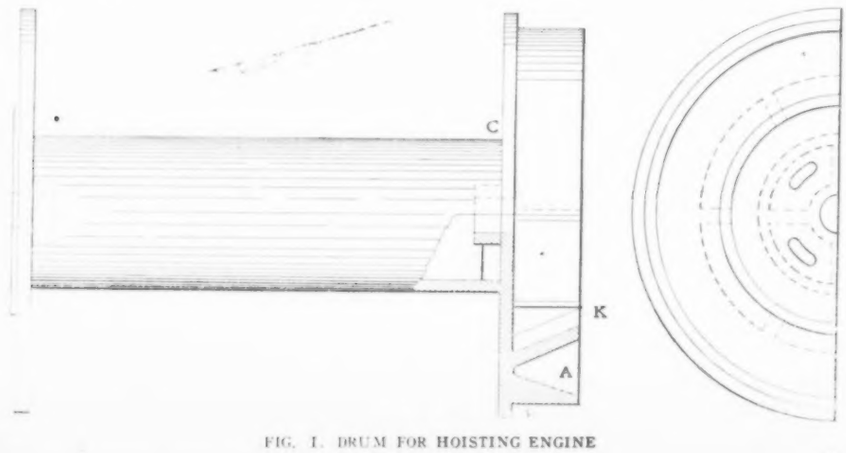


FIG. 1. DRUM FOR HOISTING ENGINE

it not for the brackets *L* which are placed in the core formed by *K W*. Many loam molders would probably want this sweep made in a different way but this is really the quickest way though it may look unhandy.

The only molding to speak of on this job is in the core. When the cheek has been swept up and lifted away the top of the core *K W* is marked off and the six bottom cores under *D*, Fig. 4, are made up by using the frame, Fig. 7. In three of these cores are placed tapered cast-iron guides, as shown at *S*.

The lower core plate shown in Fig. 9 is cast with prickers *N* to come between each and every arm of the spider; three staples *O* by which it is bolted to the upper plate; three holes to correspond with *S*, and numerous others for venting purposes.

This lower plate must be turned bottom up until the bottom spider has been molded and dried, when it is turned over and placed on the six cores previously mentioned; then the rest of the core is built up on it. The upper plate requires only one row of prickers, that around the outside edge, three staples *P*, vent holes and holes for the bolts from *O*. The upper cores *D* are formed on the main core and leave a plain, flat surface for the covering plate.

Fig. 10 shows a peculiar drum for an electric hoist and the way it was molded. A sweep like Fig. 5 was first used with the addition of piece *T*, Fig. 10, to sweep the runner shown. When this sweep was removed the four cores *U* were made up as at *W* by the use of the piece shown in Fig. 13. Then the deep portions of the mold were stuffed with paper and rags after which the thickness of the whole lower flange was filled with green sand and struck off for the parting, level with the point *X* by using a sweep like Fig. 5 upside down.

Some loam was spread over this and a grating 1¼ inches thick (partially shown at Fig. 11) was rubbed down as at *Y*. A double course of bricks was built on the outer edge in which were set four down gates *J*.

The whole space between the flanges was filled with a loam mixture that would give freely when burned, two rows of vent rods were placed, a few inches apart, all the way round as at *Z*, and this portion of the mold swept to shape; upper cores *U* were then made to correspond with *W*. Recess *M* was formed after the sweep had been removed by the block shown in Fig. 14, and was secured to the rest of the mold by a small arbor with two rods cast in; these rods passed through and were held by four small staples cast at *F*, Fig. 11.

Gates were cut from runners formed by *T* into both flanges. This core was lifted by four staples as at *F*, Fig. 11.

The mold when completed was cast with two ladles and filled very quickly. Other features of the job are common to many loam jobs.

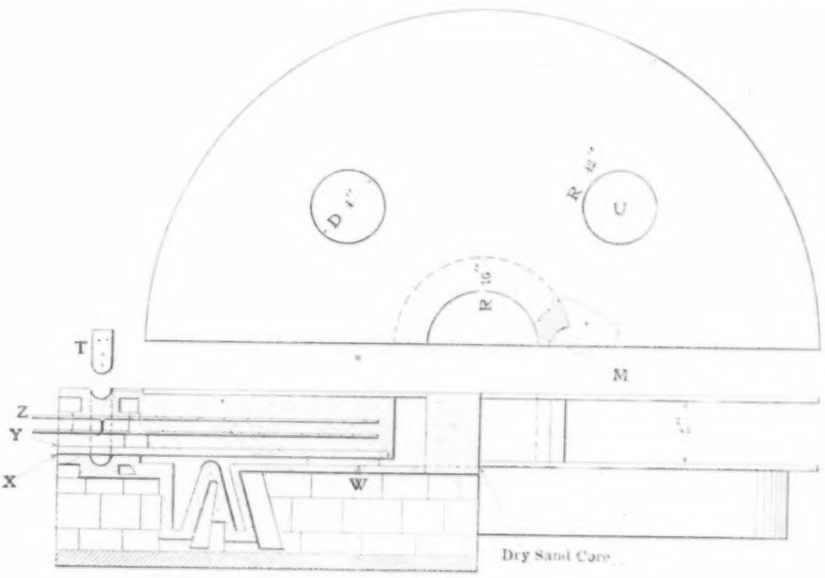


FIG. 10. DRUM MOLDED IN LOAM WITH SWEEPS

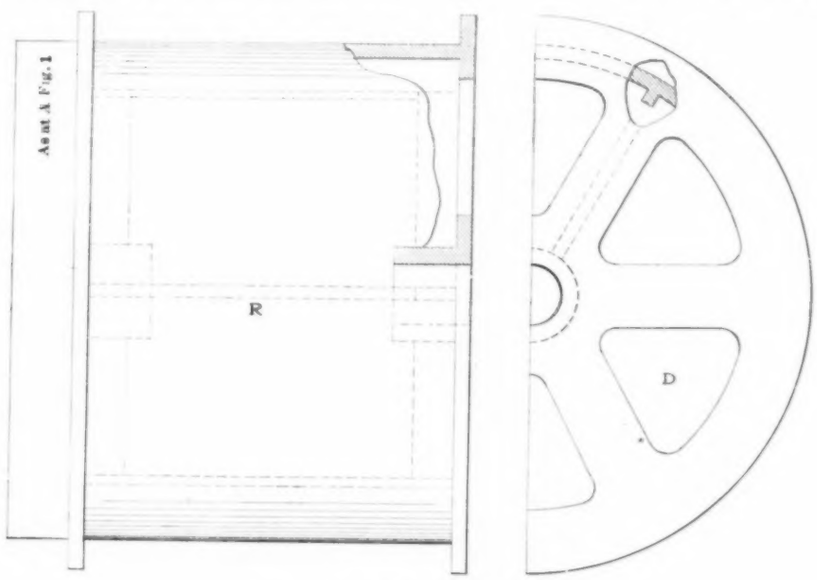


FIG. 4. ANOTHER STYLE OF DRUM

Industrial Training

BY ENTROPY

Mr. Hardy's article, at page 904, set me to wondering if the prospect of trade schools of a grade that would suit him is as small as he seems to think. Just after seeing his article I received notice that the Massachusetts Commission on Industrial Education would give a hearing on an important phase of this question on December 19. While the topic of the hearing was the question of the advisability of establishing industrial colleges, I felt that there would be a good chance to find out how the general feeling of the public was running as regards trade schools in general.

My opinion was fully justified; while the hearing hardly could have been satisfactory to the commission, it gave me what I was after. Instead of writing a report of the meeting I will set down the impressions that I gathered before and after, as well as while there.

ATTITUDE OF THE WORKINGMEN

In the first place I found a very decided change in the attitude of labor men toward these schools compared with what I reported last year. Then there was a strong feeling among the better informed leaders in favor of the proposed schools, but also a tone of decided uncertainty as to whether their followers would follow. Now this uncertainty seems to be at an end. In its place is a demand in no uncertain tones for such schools, and that such schools, if once established, shall live up to their names and really teach a trade,

or so much of it as is possible in a reasonable time, to the end that a certificate of proficiency from a trade school shall fill the place which a union card legitimately should, and no doubt in most cases does fill. That is, there is a demand that the school's certificate shall show that its holder is not a claim jumper, but that he has worked and earned his right to be classified as a journeyman.

I believe that whenever such a school is established it will find its most efficient allies in these trade unions, for they will hold it to its promises to the letter under pain of their displeasure, which would mean the ostracizing of its graduates. Workmen realize more than anyone else that learning a trade means working at that trade, not merely reading about it nor even playing at it with toy models, but really working with something of the snap and hustle of real life. You cannot persuade a man who has served three years to learn boilermaking to accept beside him in the shop as his equal another man who has merely read about boilers for 30 years. Nothing but the real thing will do for him.

The fear which labor men seemed to hold a year ago that education would overcrowd their ranks and lower their wages was pretty well taken care of in a most vehement speech by a little socialist from Brockton, in which he passionately demanded trade schools for himself and all his relations, and wound up by saying that a workingman's worth lay in what he knew, and that after he became educated it would be his own fault if he did not see to it that the "spoils" were divided right. To which I will add that when the laboring man is rationally educated he will know enough to know what a proper division of the spoils means, that is, when the general run of workmen are capable of understanding the varied expenses of a business they will be capable of seeing how the "spoils" may be fairly divided.

A Vital Idea

The most vital thought of the whole hearing came from a man whose name I could not get, though I sat next to him all the evening. His point missed fire, so to speak, because it came toward the last of the evening and because he did not elaborate it. To put it in form, it was about like this: We will always have to be content with something less than perfection in man in any stage of life, and we will have to be content with less than what might be attainable if it were not for the fact that a man who is very capable in one of the lower things will prefer to do one of the higher things even if he is less successful. For example, we must not expect to obtain very skilled machinists so long as there is open ahead of them an opportunity for promotion. They will not stagnate there and do the fine work that comes from some countries where advancement is not so easy. Out of 100 machinists, or men who attempt to be machinists, a very few, perhaps three or four, will be found that have the natural gift of executive ability that will make them foremen. They may not be ones who would make the best machinists, however. But there are other openings than foremanships for men of mechanical ability, which do not require that peculiar ability which my neighbor of the evening said was born in a man and not made. The men who can fill foremanships and places in stock rooms or in drafting rooms, will again find that out of their number there will be some who can climb higher; and so on till if every man could be assured of getting into the right kind of work, every place would be automatically filled by a man content to hold it, either because he found it a stepping stone to something higher or because he had already found that he could not go higher, even though the way and the education were open to him. If we expect industrial contentment, it can only come about when every man has an equal chance to develop what brains he may have inherited. When a man knows that nothing stands in the way of his advance but himself, then he has nothing to say, but must cover up his defects as best he may.

If a man can once advance to a foremanship, or to any stage above that of the artisan, then if his ambitions carry him farther he will find in any State technical schools which will answer his needs. If he is capable of earning money above the grade of an artisan in his particular line, he will be capable of earning money enough to put himself through the school.

Consensus of Opinion

The general consensus of opinion among those few who seemed to have given the matter thought was that the trade school which should give its pupils training in the actual handiwork of their crafts was all that is needed at present. In fact it seems to be actually demanded by the very men from whom the leaders of this movement feared the most. For higher technical training these trade schools may very well be depended upon to fit such of their students as show ability for any one of the three institutions of technical training that are already established in Massachusetts. While the object of trade schools would not primarily be that of training schools for the technical colleges, they would be sure to find some boys who, if given a chance, would do honor to any school. So far as opinions were expressed at the meeting, it seems to be that this was the best way to leave the question for which it was called.

From all over the State there seems to be a word of progress in the matter of the elementary trade schools, slow progress to be sure; but we must remember that this is Massachusetts, not the West, and also that the idea of having these schools actually teach trades, not a smattering of things which might be useful to an artisan, but real practical trades, has made the problem harder than it would have been if the question had been that of establishing advanced manual-training schools, as the writer feared a year ago.

Lawrence has the record of appropriating the first money for this purpose. Fitchburg is working along. Worcester is waiting for its new mayor to take his chair, and from many of the other cities word comes of an increasingly hopeful attitude toward the matter.

Economy in Machine Design

By Sterling H. Bunnell

The ideal in the design of machinery according to the books is the "one-horse shay" principle; each part must be as strong as the rest. In laying out the parts of a machine it is planned that each shall contain the minimum weight and afford the maximum strength. This principle in practice must be modified by two considerations which are not usually taught in schools and are often overlooked even by draftsmen of experience.

The first and most important requirement is rigidity. A beam of uniform strength for a given depth and length is not as stiff as a beam of equal strength, but of the same depth throughout. The deflection of members of a structure may be extremely objectionable. This is the case with steel floor beams intended to support plaster ceilings or masonry. Such beams must not be loaded to their safe limit of strength unless much shorter than would be proper for beams of equal strength supporting more elastic superstructures. The deflection of the longer beams would cause cracks in the masonry or plaster. In machine-tool design this requirement is imperative. In the endeavor to provide sufficient stiffness to prevent deflection under the strain of the cut, together with sufficient mass to absorb vibrations in operation, the weight factor has become the ruling one; machine tools are frequently purchased on the basis of weight with little regard to other equally valuable factors.

While in recent years the requirement of rigidity has received some measure of the attention it deserves, another condition is almost invariably overlooked by designers with purely technical training, or at least without direct practical experience in estimating costs. This is the desirability of reducing the cost of the machine. The use of structural-steel beams is a direct application of this principle. It is cheaper to roll beams of uniform section and therefore of wasteful dimensions—the beam throughout being of the

section required at the point of maximum stress—than to shape the beam to give uniform strength throughout. The change made years ago from cast members to wrought members did away with the production of economical shapes, except where a girder or framed member is built of elements of uniform sections, which can be so varied, in location and in their separate dimensions, as to make the member as a whole approach the condition of uniform strength and minimum weight throughout. All through the design of the machine, the question of cheapness of production is fully as important as that of strength. In practice it is not enough to build a scientifically correct apparatus; it must be built as cheaply as any other production of equal merit.

The draftsman of experience can look back over his work and readily recall one instance after another where his attention has been brought to ingenious methods of using cheaper devices which gave exactly as good service as more expensive ones. By changes in design he has been able to core holes which otherwise must be drilled; to use rough bolts and yet locate the bolted parts relatively one to the other by single dowels or other means; to plan so that portions of an apparatus may be "thrown together" with the certainty that they will fit; to simplify construction so that no time will be lost in deciding which way a piece must be placed rather than allowing apparently two or three possible locations.

Directly connected with the desirability of economical construction is the use of commercial or stock sizes wherever possible. Repeatedly in completing a design it is found that certain parts are longer or wider than can be purchased without long delay and special construction. In such cases it is worth while to revise the whole design so that stock material may be picked up readily in the market; conversely, the designer should look ahead as his drawing proceeds and avoid the use of materials of impossible or inconvenient dimensions. A training in the estimating department cannot fail to be of great service to any draftsman.

Making a Novel Gun-barrel Mandrel

A Trying Piece of Work That Must Be Very Accurate and That Is Used in a Novel Process of Making Gun Barrels

BY EUGENE C. PECK*

The making of these mandrels is one of the most tedious and trying pieces of work that an ordinary toolmaker accustomed to good work is usually called upon to do. To turn out a satisfactory mandrel each operation must be accurately done, and to accomplish this requires a clear head and endless patience. The workmen who have anything to do with an order for several of these tools usually receive all kinds of well meant advice pertaining to the proper training necessary to tackle the job; as it takes some time for the order to get through, there is ample time to get a nervous man worked up.

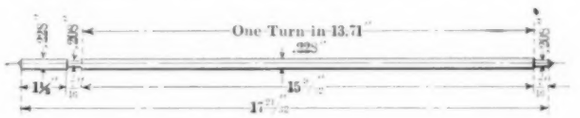


FIG. 1

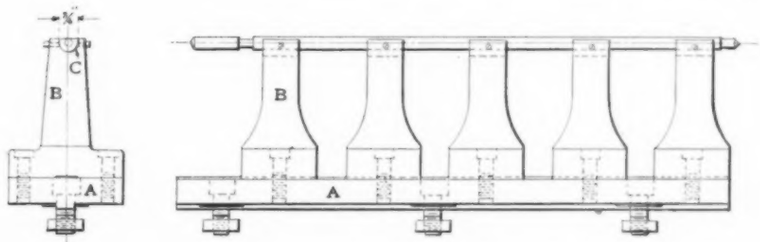


FIG. 2

DETAILS OF THE MANDREL AND ITS SUPPORT

The mandrel seen in Fig. 1 is 17 21/32 inches long. Beginning at the left, the part 1½ inches long is round and 0.225 inch in diameter. There is a recess at each end, both round, 7/16 inch long and 0.208 inch in diameter; the portion between the recesses, 15 9/32 inches long, is a 12-sided spiral, one turn in 13.71 inches and to the dimensions given.

The purpose for which the mandrel is intended necessitates a gradual and uniform taper to the 12 flat sides, and this taper is limited between 0.0015 and 0.002 inch in its length. The respective diameters across the corners and flats must be the same. These mandrels are to be used in the manufacture of 22-caliber rifle barrels, and the writer understands that the process is somewhat as follows:

Over the mandrel is slipped a tube which it just fits. This is then placed in a pair of specially constructed knuckle dies having in each half a half-round groove as long as the barrel, forming a round groove of proper diameter. The dies have plates at each end, fitting close to the mandrel, to prevent the stock from flowing endways. The dies are used in a special all-steel single-acting press which exerts about 400 tons pressure on the dies at each flow, 20 being required to complete the operation. The mandrel is then withdrawn, leaving a rifled gun barrel. From this it will be seen that the mandrel must of necessity be a very good piece of work or it will not pull out. Both the taper and the contour must be uniform the whole length.

The following method is used to make the mandrel:

Tool-steel wire of the proper length and diameter is chosen, and about 0.005 inch is rough ground from the outside to insure equal hardening all over the surface. The pieces are heated in a lead bath to the proper heat by the aid of a pyrometer and drawn in an oil bath. After careful straightening they are ground up to the exact diameters across the corners, and the recesses properly located. This grinding, as those familiar with this kind of grinding will readily see, is in itself a difficult and tedious piece of work. The mandrel when leaving the grinding machine must be round, of a uniform taper and true on the centers.

The next step is to grind the spiral flat sides; this is done in a fixture on a universal milling machine, arranged to grind the spiral flat sides with an emery wheel mounted in the vertical spindle attachment. The fixture for holding the mandrel was made as follows: The flat part *A* in Fig. 2 was scraped up flat on top and an accurate fit on the milling-machine table, located at a fixed distance from one

*General superintendent, Cleveland Twist Drill Company, Cleveland, Ohio.

end. This was held down by three screws, and the surface on the bottom of the plate A, was relieved all over except a small portion surrounding the screws. The small cast-iron posts B had been previously drilled, tapped and doweled into position; they were accurately scraped so that they could be taken off and put on and the alinement remain the same. The hole C in these castings had been previously roughed out so that the alinement would correspond with the center line of the index head. The one nearest the index head was then put in place and fastened; the hole was finished with a small boring bar in the vertical attachment swung at right angles so that the center line of the boring bar coincided with the center line of the index head. Then the next one was put in place and in turn bored out, and so on until all had been bored with the boring bar in exactly the same position. This method located the holes at a point bearing the same fixed relation to the milling-machine arbor that the emery wheel would when grinding the mandrel. This was then carefully tested with a bar ¾ inch in diameter accurately ground on centers.

Next a set of bushings was made with holes to fit the mandrel at the points representing their position in the fixture, and the outside ground up an accurate fit for the castings B. The fixture was then taken off the milling machine and the bottom spots scraped so that by accurate measurement the taper in the plate corresponded to half the taper required in the mandrel. It was then put back on the milling machine and indicated to check up the accuracy of the work. This, of course, leaves the mandrel slightly out of alinement with the index-head spindle, but this is taken care of by a small light universal joint which allows the mandrel to turn freely without cramping. The milling machine is then geared up to the proper spiral, an emery wheel placed in the spindle of the vertical attachment and the mandrel ground up.

Great care has to be taken not to heat the work, as it is found that any appreciable amount of heat bows the mandrel into the wheel, cutting it too small; a cut one-tenth of a thousandth too deep will spoil it. It is found that before starting to cut when the mandrel is anywhere near finished, the machine must be run for a time so that the milling-machine spindle will assume the temperature at which it will be as the work progresses. The cut once started has to be finished on all 12 sides before the machine is stopped for any length of time, as once the mandrel gets out of round it is next to impossible ever to get it back again; this happened on the first one by the noon hour preventing the finishing of all of the 12 cuts that were started.

Great care and unlimited patience are needed to get a good mandrel; when finished a glass shows on the corners a faint margin, which is the original circle grinding.

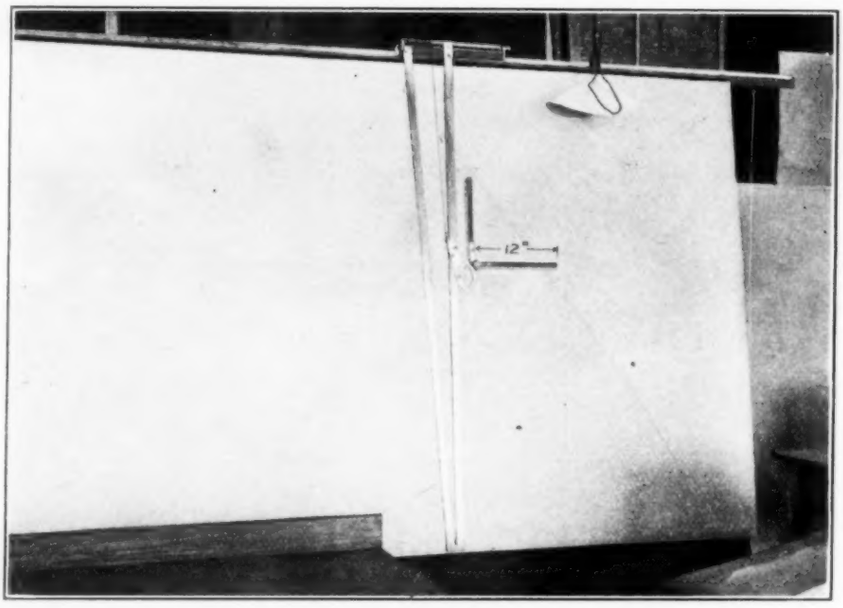
The inspection is made in the following manner: A micrometer is mounted so that a pair of rests bring the mandrel in the center of the anvil. Readings are taken around the mandrel at every inch and noted; then the mandrel is drawn through the micrometer faces to detect any error in the uniformity of taper.

A notable example of the industrial advance now taking place in Mexico is the recent erection of a packing house covering about 20 acres of ground. The power used is electric and the machinery equipment comprised 45 carloads, 95 per cent. of which was of American make.

Making Six by Ten Foot Drawings

By H. F. Noyes

All draftsmen and engineers recognize the value of full sized drawings in designing. Any smaller scale is more or less deceptive, and very frequently a pattern made from patterns of a smaller scale when it appears life size looks so different from what was expected of it that a change is necessary. And especially when working on anything new is it desirable to work to full size scale. And on a large machine, where there is a good deal of detail it is often necessary to make a number of drawings when one would answer the purpose if a suitable scale could be used.



MAKING LARGE DRAWINGS

Recognizing these facts the Landis Tool Company, of Waynesboro, Penn., have built in their drawing room a board adapted for drawings six feet high by ten feet long.

The board and outfit are illustrated in the accompanying photograph. The board is supported in a nearly vertical position upon two uprights, by ropes which pass over grooved pulleys to two balance weights. As it was not practical to cut

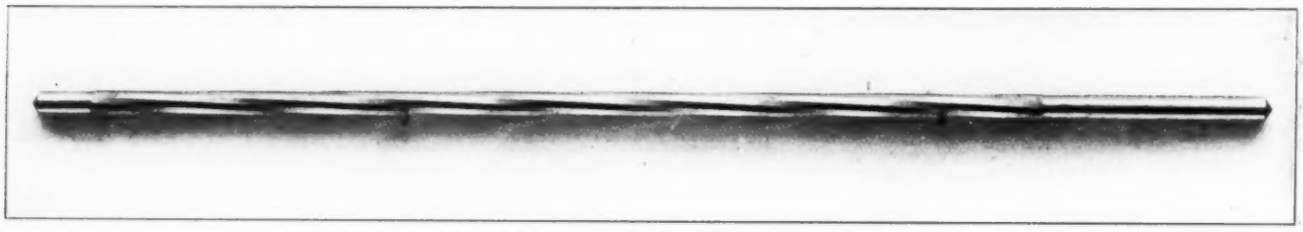


FIG. 3. THE FINISHED MANDREL FOR RIFLING GUN BARRELS

cut the floor, a platform, light in weight so it could be easily moved, was made, and this enables the draftsman to easily work at the top of the board, when the latter is down; and the board can be raised high enough that he can as easily work at the bottom of the drawing.

Formerly the board was a blackboard, and chalk was used for laying out drawings. But this was a tedious and inaccurate method, being used for only a few general lines and little detail could be put in; and as a result the board was little used. Recently, however, the board has been fitted with an adaptation of the vertical T-square designed by the writer.

The top of the board is provided with a straight steel track, upon which rolls a carriage carrying the T-square. In order to use the Noyes form of drawing instrument made, the blade of the T-square was made the same cross-section as that usually furnished with these instruments, and the blade was stiffened by a brace. A large spring balanced roller at the top of the carriage supports the instrument and will balance the latter at any part of the drawing. Long parallel lines are obtained by clamping the instrument to the vertical blade and moving it with the pencil across the board as far as may be desired.

With this outfit it is practical to make finished assembled scale drawings of a pretty good sized machine, as easily and accurately as on a regulation board, and since its installation we wonder how we got along without it. With a full sized section or view of a machine a person can stand in front of the drawing in his proper position for operating and see how handy each operating lever or handle or mechanism is going to be, and see just where he will have to reach to put his hands on the different parts.

Another advantage is for pattern drawings, particularly for cross-sections of machine beds. These are made to the patternmaker's shrink rule and he can then readily fit his templets to the drawing.

In order to keep these large drawings in such shape that they can be readily handled, studied, or worked from, a light frame is made, like a screen and the drawing tacked to that. These screens can be readily moved about and thus kept for reference until a machine is worked up when the paper is removed and kept in rolls. Cross-sections of standard machines are kept on screens for reference.

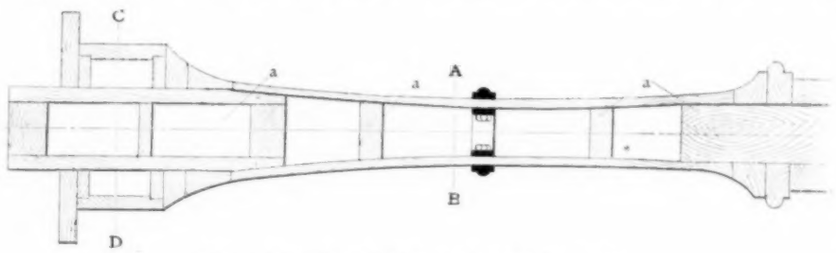


FIG. 1. SECTION THROUGH A COLUMN PATTERN

Pattern for Column

By N. Patton

The making of a pattern for a column is not generally a difficult job; but there are columns and columns. Some are simple and some are not. The one shown in Fig. 1 is 15 feet long and out of the ordinary in so much as it is a curve all of its length.

To have made this pattern in the ordinary way would have entailed the use of comparatively thick staves and therefore

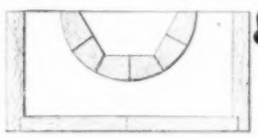


FIG. 2 SECTION THROUGH C D

FIG. 3 SECTION THROUGH A B

materially increased the cost of the pattern. The way we overcame this was to put a full-size lay-out on a board in order to get the true form of the curve required. This board was afterward cut out to form and used as the core board for making the loam core.

Sections through the diameter were then laid out and marked off to allow for lumber of 2-inch thickness being used. The internal stiffening and fastening blocks, as shown at *a a*, Fig. 1, were made to suit. These blocks were then fastened to the lay-out board, the pattern being made in two halves; the two outside staves were bent and fitted to the blocks. The remaining staves were then fitted to these and to the blocks, six staves being used for each half of the pattern. Owing to the length of the column, it was not a difficult job to bend the staves into position.

It will be noticed that the print which also forms the fastening piece at the large end of the column was built up. This was made to the form shown in section by Fig. 2. It was turned the full length and then tapered off at one end to receive the staves.

The way in which the other parts of the pattern were put together is shown in Fig. 1. It will be noticed that beside taking a less amount of lumber it also resulted in all the pieces having the grain of the wood come in the best positions.

Fig. 3 shows an enlarged section through *A B* of Fig. 1, at which point two wrought-iron bands 3x½ inches were bolted together through the staves, one on the outside and the other on the inside, to insure the staves being kept in position.

Grinding Formed Milling Cutters

By B. F. Newcomb

I am deeply interested in the discussion of grinding formed milling cutters and fully agree with the advocate of a roughing and finishing wheel. But I would advise a coarser and harder wheel than Mr. Abbott specifies for roughing. I would go down into the twenties for a grit instead of forty and make the grade or temper an M instead of K. The finishing wheel I would select according to class of work to be done, making it as coarse as possible in consistency with requirements of cutter. I have yet to see where a grade M wheel did not give good results on hardened steel if combined with the proper grit.

A proper specification of grit and temper in ordering will give such results on any class of work that the wheel will clean itself and still not wear away any faster than is absolutely necessary to keep clean. If it does not keep clean it will not do the amount of work it ought to. Greasy work should never be presented to an emery wheel, and I am assuming that we are dealing with cleaned work only. A wheel that does not clean itself, but becomes glazed is too hard or the combination of grit and temper are not proper. A proper combination of the two and our troubles from heating or burning become minimized.

Too few of us give the emery-wheel question its due consideration. But there is just as much room for a profitable selection in them as in our machine-tool equipment or the methods we employ in machining operations. By giving this branch a little study I was able to do a certain class of work in just one-third of the time previously taken and also relieving the operator of the extreme care about burning. As it had been taking his whole time one can readily see what a saving there was in wages as well as to be able to deliver the work promptly and keep in full operation the machines using these tools. The results to be attained in this line are surprising and in nearly all shops that have come within my scope, little or no attention was given it. Those who have not given it much thought will be well repaid by doing so and meet with pleasing results. You will then be able to grind on the side of the wheel best adapted to the form of your cutters and get the results you are looking for in the time it takes. One wheel will not do all classes of work any more than a roughing tool would do for finishing in a lathe.

The Growth of Cast Iron by Heating

By A. E. Outerbridge

While it is pleasing to hear from time to time of new practical applications in the mechanical arts of the principles enunciated in the paper entitled "The Mobility of Molecules of Cast Iron," presented before the American Institute of Mining Engineers in 1904, I desire to call the attention of your readers to the fact that there are a number of problems of a theoretical nature suggested therein to which answers have not yet been made.

This is not surprising when we realize that properly to answer some of these will require profound mathematical acumen, akin to that possessed in so eminent a degree by the late Lord Kelvin. To illustrate my meaning, let me ask: Who will define the nature and extent of the silent forces brought into play among the molecules of a specimen of ordinary cast iron machined to a size, let us say, of one-inch cube and then permanently enlarged by heating and cooling, say one-eighth of an inch in each cross dimension, this being an increase of approximately 40 per cent.?

We all know that in order to overcome the attraction of cohesion among the particles of a cast-iron bar it is necessary to subject it to a tensile strain of from 20,000 to 30,000 pounds per square inch, and in the case of some specially strong kinds of gray cast iron to stresses of considerably more than 40,000 pounds per square inch in order to produce rupture. Even then we find very little yielding or stretching of the particles, so close is the tie that binds them together. Yet, amazing as it may seem, without exerting any exterior force other than that of heat which has never even approached the point of softening the metal, or of plasticity, we have caused each individual molecule of iron to move apart from its immediate neighbor, never to return to its former close relationship by any process short of remelting the mass.

Close examination under the microscope of polished and etched sections of a bar before and after this permanent extension has taken place proves conclusively that the forces of repulsion, of whatever nature they may be, have been exerted uniformly and continuously on each particle of metal wherever situated, that is, near the edge or near the center of the piece. The micro-structure of the expanded metal is very similar to that of the unexpanded bar, but the inter-molecular spaces are much larger, as might be expected, in the case of the expanded bar.

Can we satisfy ourselves that we fully comprehend the nature of the extraordinary change in bulk of cast iron when subjected to alternate heating and cooling? I confess that the investigations I have made on this subject from many different points of view have not satisfied my mind. They have only enabled me to ask a number of questions and perhaps to make some shrewd guesses. The fact that the problem was placed squarely before the scientific world when these investigations were published nearly five years ago, and has not been answered today, seems to indicate that the nut must be a hard one to crack.

My first question, near the beginning of this paper, should appeal not only to the practical man, but to the original investigator in pure science. Let us look at it for a moment from the chemist's and metallurgsit's point of view.

In cast iron we have one of the most highly complex alloys. In addition to the iron, which comprises over 90 per cent. of the mass, we have other elements differing widely from each other in all their characteristics, thus: phosphorus, which melts at an exceedingly low temperature; and carbon, which does not melt even in the electric arc. Again, if we look at the chemical structure of the metalloids, we find that each of the five or more components of cast iron possesses a different "valency," that is, atomic combined equivalent; thus phosphorus is a tri-valent element while carbon is a quadri-valent element. Therefore we have in cast iron, as I have said, compounds of the most complex character it is possible to imagine.

What living chemist can point out the nature of the dance of the molecules of cast iron when under the stimulus of heat? How many times do these elements change partners before they assume fixed relation to each other?

A still further complication is introduced when we begin to speculate upon the possible influence of the pressure of oxygen, a bi-valent element, and its combinations with iron, carbon, sulphur, phosphorus, manganese and silicon. This subject has been a hobby with me for many years, and the idea that an alloy like cast iron, containing 3 or 4 per cent. of free carbon, could have even a trace of oxygen was ridiculed; now it is stated by some writers that a few thousandths of 1 per cent. of oxygen exert a more powerful influence upon the metal than ten times the quantity of such elements as sulphur or phosphorus.

Hydrogen, a uni-valent element, is now sometimes mentioned as a component of cast iron, exerting a weakening effect upon its structure.

In further study of some of the non-practical features of this subject, I would recall the singular difference in behavior of a thin section of an expanded cast-iron bar when immersed in distilled cold water as compared with a bar of the same metal in normal condition when plunged into the water. We will assume that we have first taken the precaution to weigh the specimens accurately on a chemist's balance. The piece which had not been expanded when dropped into a beaker glass of clear distilled water remained quiescent; but the expanded section immediately became covered all over with fine "beads of perspiration," as some one expressed it. Little bubbles of gas appeared all over the smooth surfaces, growing larger and larger until they would break away and rise to the surface. The lively ebullition continued for about half an hour and slowly ceased. On removing the piece from the water, drying with a cloth and reweighing, it was found to have gained considerably in weight. The same phenomena were observed when pieces of the expanded metal were immersed in other liquids, such as alcohol, benzine, turpentine, etc.

Again the questions were asked: What is the meaning of this bubbling and what is this gas? Does it come out of the iron or the liquid?

A little patient investigation enabled me to answer these queries satisfactorily to myself and others. The bubbles of gas were simply plain air absorbed by the iron in cooling, the metal having become to a certain extent porous owing to the pushing apart of the molecules. When the expanded bar was dropped into water, the pressure of the water on all sides drove out the bubbles of air, and water seeped into the heart of the casting, not through channels or visible air holes, but through the whole structure. In order to obtain the true specific gravity of the expanded metal, it was necessary to coat the specimen with water-proof lacquer before immersing in the water.

The specific gravity of the specimens of cast-iron bars that were subjected to investigation ranged from 7.14 to 7.25. The specific gravity of the expanded metal varied with the amount of expansion; the average of a large number of tests was about 5.8, though some records were below 5.

In conclusion I would say that it is a matter of some surprise to me that these finely theoretical or non-practical features of the discovery have not been made, ere this, the subject of investigation by some of the great institutions of learning, such as the Carnegie Research College, with its endowment of millions of dollars for the prosecution of original scientific research, or other similar institution.

Some time ago Prof. Theodore Richards, of Harvard (recently named by Owen Wister as one of three great teachers in America), wrote to me stating that my discovery of the permanent exhaustion of cast iron had afforded him the first practical illustration to his new theory of the compressibility of atoms; but beyond this I know of no further use that has yet been made in the colleges of the principles announced in my paper.

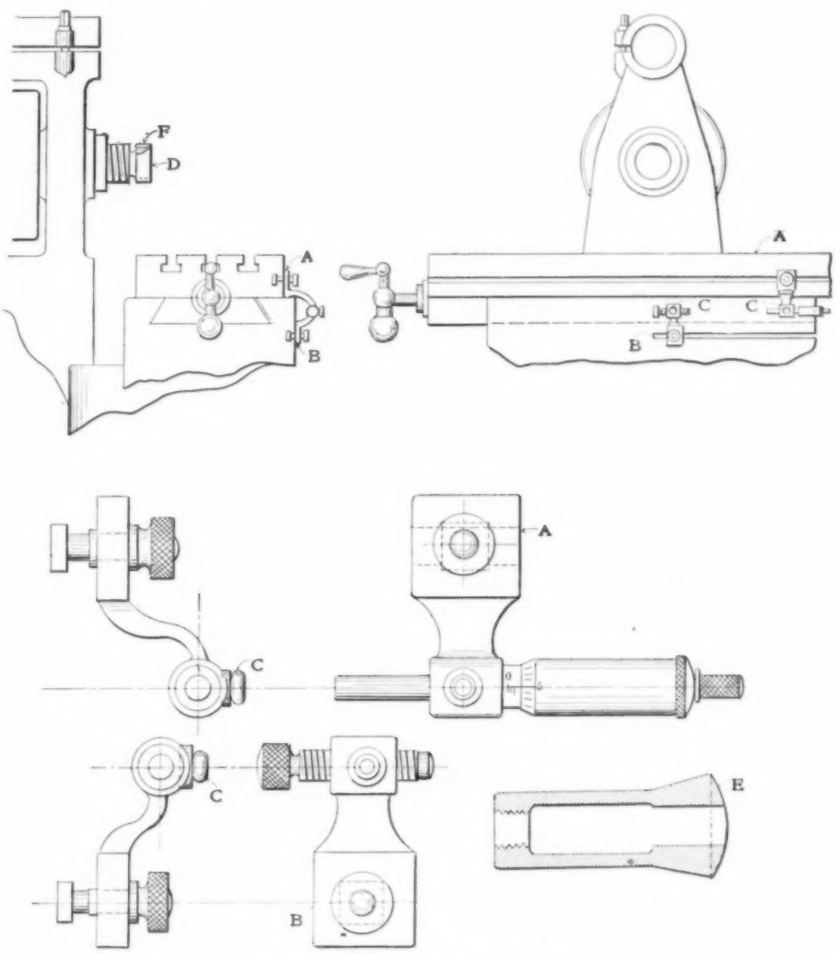
Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Stops for Locating the Miller Table

The sketches show a very good scheme for use when locating and boring holes on the milling machine. In the saddle of the machine there is a T-slot milled for a ¼-inch bolt; a similar but larger slot is shown in the table which usually carries



STOPS FOR THE MILLER TABLE

the dogs for tripping the feed. Into these slots parts *A* and *B* are fitted, the essential parts being made in correct alinement with one another. *A* carries a 1-inch micrometer head, and *B* a nurled-head screw which is used to facilitate the setting of the micrometer at any required point. The screw, which is made with a fine thread, has a rounded point and acts as an anvil to the micrometer head. This arrangement is for setting the table where the holes are bored in the jig 1 inch or less apart and needs no explanation. Standard end-measuring rods can be used in getting lengths longer than 1 inch.

In the front side of *A* and *B* there are fitted and soft soldered in place two hardened buttons *C C*; these are used in connection with a vernier for taking measurements over 1 inch in length, the vernier being in correct position when the sides of the jaws are held against the shouldered part of these buttons. The jaws of the vernier take the measurement over the ball-shaped part of the buttons. A hardened taper plug *D* fits the spindle of the milling machine which carries spring collets, a section of one being shown at *E*. These collets need no explanation, except that they carry all tools needed in boring, drilling and reaming operations. They are threaded internally at the rear for the draw-in rod which passes through the spindle of the milling machine and are clamped by a hand wheel in the usual way. A soft sleeve *F* is forced on plug *D* and becomes a permanent part of that fixture. Before starting on a piece of work, *D* is driven in place, and a very light smooth cut is taken off *F* with a tool held in the milling-machine vise. This forms a true place to take vertical measurements from by the aid of a hight gage used as shown at page 634. A scheme in this connection is to use a strip of tissue paper as a feeler between the jaw of the hight gage and *F*.

Detroit, Mich. CY. PRESS.

Short Cuts in Drafting

The recent articles on the so-called short cuts in drafting are very interesting, as they show the differences between draftsmen. The only fault I can find in them is that they do not qualify the statements made as to the conditions under which the short cuts may be used. However, it is certain that some of them, at least, would find favor only in a small drafting room where the one man does the whole operation of designing, detailing and tracing.

Imagine a designer putting a piece of tracing cloth over his design and tracing off one view of a detail from one part of layout, then shifting to another portion for another view and so on, if more views are needed, or drawing out another view on the tracing cloth! Anyone who has tried this last scheme will surely agree that it isn't the most satisfactory operation. While the designer is doing all this the cheaper men are waiting, and so is the next designing job. It is a poor detailer who cannot detail the piece ready for the still cheaper man, the tracer, in the same time that the designer takes to do the whole thing. The tracer's time is more than offset by the time taken by the designer in looking after the small details as to using standard parts and sizes and dabbling with pen and ink. If one man has to do it all, I have still to be shown that detailing on a separate sheet and then tracing has a rival, either in time or in the satisfaction of having a drawing that can be used in the shop.

It has been my good luck to try the short cut under both of the above conditions, and also to see the practical results of a man who used the short cut to find time for himself to spend looking out of the window. The man who paid for the time in the shop evidently did not take a very great liking to the system. Let us try the short cut of removing the pen from the compass when

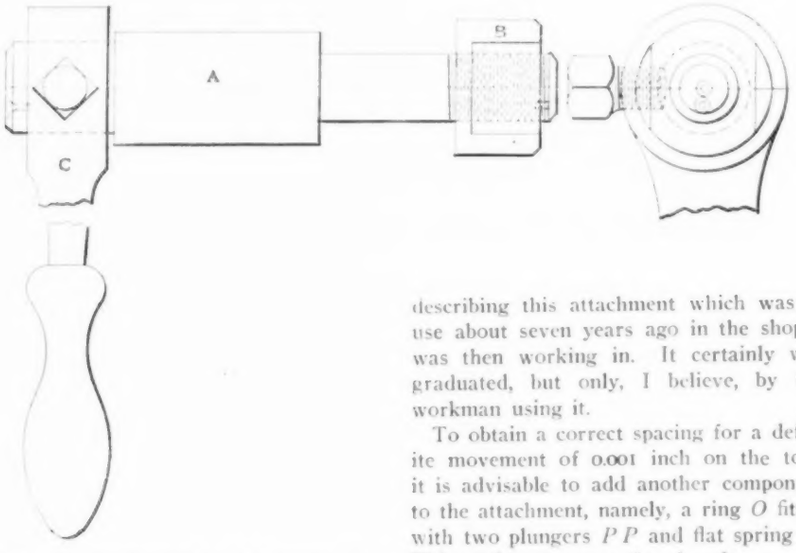
making straight lines. First, isn't the easiest and quickest way to make a tracing to make all the circles and arcs first? Then make the straight lines. How often is it necessary to change from compass to pen? How convenient it would be to take the compass pen with its short and awkward handle for straight lines or, even worse, to straighten out the compass and have a long sharp-pointed handle to stick into everything in reach. While a man is taking out the pen or straightening out the compass he could pick up his ruling pen, that is, if his table was in such order that he knew where to put his hand for it. Of course he has to fill it, but the compass pen also has that failing, and as any pen should be cleaned frequently to get good results there is no occasion for a loss of time in that respect. In conclusion let me ask: Why do the authors of these short kinks use a pencil? Why not use the compass pencil, as several minutes a day are lost when changing from the compass to a pencil? C. J. F.

Grand Rapids, Mich.

Packing Off Formed Milling Cutters by Hand

The illustration shows an arbor for backing off formed milling cutters so that they may be ground without changing their form.

The cutter is fastened to the eccentric arbor *A* by means of the nut *B*. It is



ARBOR FOR BACKING OFF FORMED CUTTERS

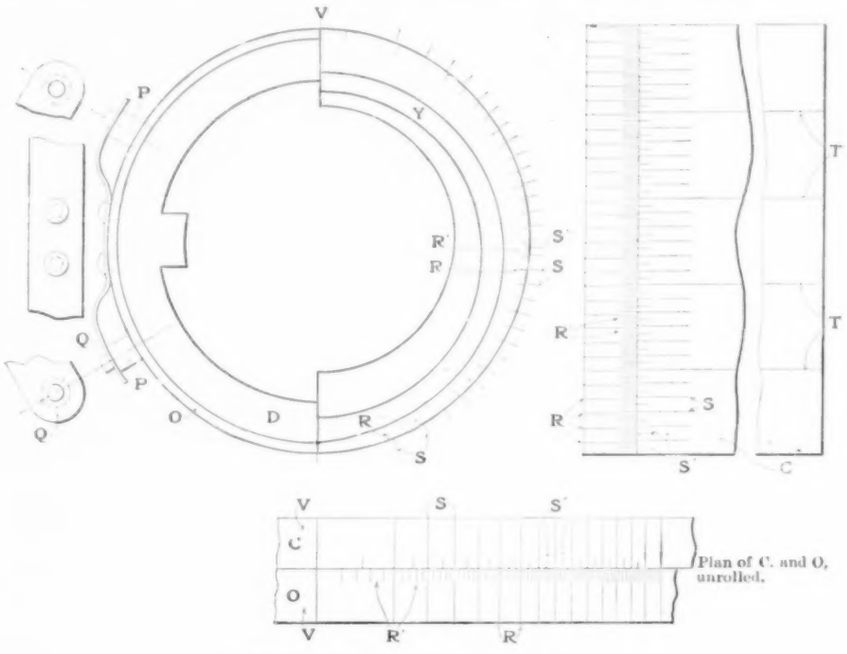
then placed on the centers of the lathe and rocked with lever *C*, which is fastened to the arbor in a certain position to give the proper clearance to a tooth of the cutter.

With this tool each tooth is backed off complete, then the cutter loosened and the next tooth brought into correct position in relation to the eccentric center.

Hartford, Conn. P. F. SETAG.

Fine Adjustment for Boring Bar

On page 525, current volume, J. F. Hammond raises a query as to the graduations on the parts of the attachment described on pages 344 and 345. This is really an oversight on my part; the idea I had in mind was to add one to the very interesting series of boring bars which are being illustrated in these pages, by



VERNIER FOR MAKING FINE ADJUSTMENTS

describing this attachment which was in use about seven years ago in the shop I was then working in. It certainly was graduated, but only, I believe, by the workman using it.

To obtain a correct spacing for a definite movement of 0.001 inch on the tool, it is advisable to add another component to the attachment, namely, a ring *O* fitted with two plungers *P P* and flat spring *Q*. This spring prevents the ring from moving while a cut is being taken, but will allow it to be moved when required, the ring *D* on the original sketch being reduced in diameter 0.25 inch to bring the outer diameter of ring *O* in line with sleeve *C*.

The spacing should be marked off as shown in the sketch, a line equal in length to the diameter being divided into 30 equal parts by the lines *R* and *S*, each division being equal to a movement on the tool of 0.01 inch. The sleeve *C* is again subdivided by the lines *S* 1, reducing the reading to 0.005 inch; the ring *O* is subdivided by the lines *R* 1, reducing the reading to 0.002 inch. With this combination, although at the highest and lowest point of the eccentric there will be a slight variation, the tool can be set to 0.001 inch by the following methods: Assuming that a cut has been taken through the hole being bored and it is necessary to enlarge it 0.126 inch, return the tool to its original position when cutting and move the ring *O* so that the zero line *V* corresponds to the zero line on sleeve *C*; then reading in line with the tool, to facilitate which the lines *T* are extended along sleeve *C*, move six of the lines *S* past line *R* on ring *O*. The result is 0.06 inch travel of the tool. Next return ring *O* to zero, and in line with the tool move the line *S* past one small division *R* 1 on ring *O*. The total travel of the tool equals 0.062 inch; the line *S* 1 in line with the tool will now be midway between two of the lines *R* 1 on ring *O*. Advancing the line *S* 1 till it coincides with the next line *R* 1 will add the remaining 0.001 inch required. The total travel of the tool equals 0.063 inch, enlarging the hole 0.126 inch.

In the end view of sleeve *C* can be seen the relative position of eccentric *V*, with the difference between the divisions mentioned by Mr. Hammond. The inner set of lines *R* and *R* 1, representing the ring *O* being moved equal to a movement of 0.001 inch on the tool, thus shows the distance it is necessary to move sleeve *C* at any position of the tool for the distance required. A good method for marking off the ring *O* and sleeve *C* would be to make the travel of the tool say 0.32 inch, with the diameter of sleeve and ring 4

inches. The ring could then be marked off on a slotting machine by attaching a pointer to the movable slide and a rule to the fixed part of the machine; the ring O could then be marked off in 0.125-inch divisions for the lines R 1, the sleeve C similarly being marked off in 0.125-inch divisions for the lines S and 0.0625-inch divisions for the lines S 1.

The tool used for marking will need to be turned slightly several times, as the part being marked off will not revolve but will move in a plane at right angles to its axis. After each movement of the tool for this purpose, the position of the rule used for dividing will need to be verified before the next line is marked.

London, England. M. M. SHARP.

Laying Out a Nurl to be Cut by a Milling Machine

I was once given a job to lay out a nurl to be cut by a milling machine. I submit this as I am curious to know how it is done elsewhere.

We had previously had our nurls cut outside, so when we received our new milling machine it was up to us to prove its value. Shortly after the new machine arrived the engraver came to the master mechanic and wanted a nurl cut. The master mechanic called me and said: "Say, Walter, did you ever figure out a nurl?" "No," I said. "Well, do you think you can?" To which I replied, "I should like to try."

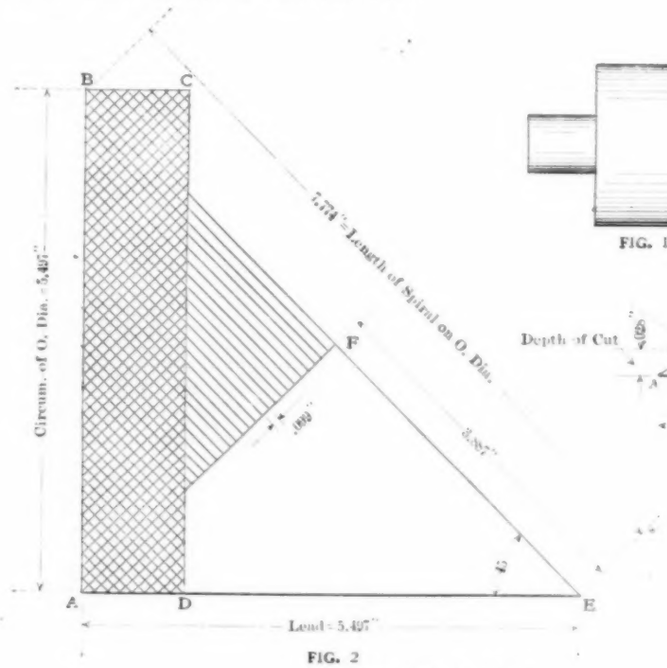


FIG. 2

LAYING OUT A NURL

He then gave me an old nurl and also a small sketch of the blank as per Fig. 1, and said he wanted it to have 39 teeth or squares on the circumferences, to be perfect squares, and the depth of cut to be 0.028 inch. He wanted me to find out the lead so he could determine the gears to be used on the milling machine, also the angle of cutter that would cut that depth and produce the desired result.

I thought it best to lay it out on paper as at Fig. 2, $A\,B\,C\,D$. Line $A\,B$ equal to the circumference of the nurl. I then divided $A\,B$ into 39 parts which gave me the divisions for the number of squares. From these intersections I drew 45-degree lines which gave me the squares. Then I extended the line B to E and A to E, which gave me the length of the spiral, also the lead, equal to the circumference. I had to determine the angle of the cutter so I bisected $B\,E$ at F and drew $F\,A$ and $F\,A = F\,E$, and by extending my 45-degree lines to the line $A\,F$ found that the base of each square or tooth was equal to 1/39 of $A\,F$, which equaled 0.099 inch.

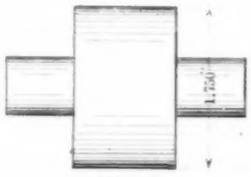


FIG. 1

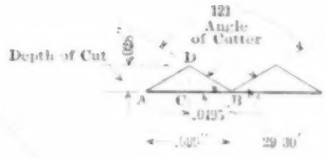


FIG. 3

Then each square being made up as per Fig. 3, it was an easy matter to figure the angle required.

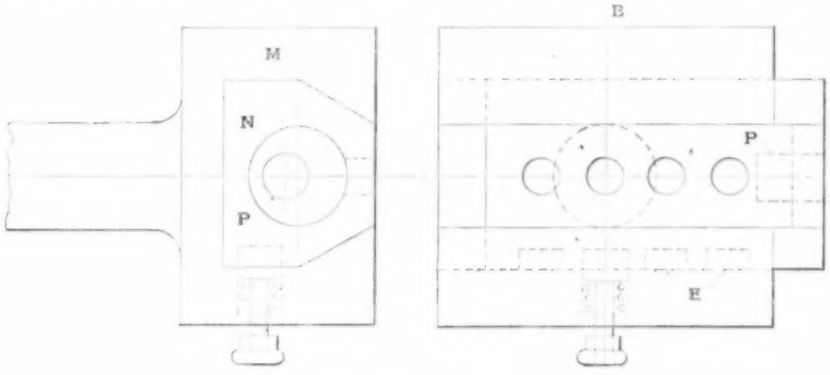
$A\,B$ = 0.099 inch, then $B\,C$ = 0.0495 inch and $C\,D$ = 0.028 inch, or the depth of cut then the tangent angle $D\,B\,C = \frac{0.028}{0.0495} = 0.5656$. Looking up natural tangents we find the angle equal to 29 degrees 30 minutes. Now multiplying by 2 and deducting from 180 degrees gives us the required angle of cutter which resulted in 121 degrees, for which we used a 120-degree cutter. After that I had quite a number of nurls to work out and found the method to be correct, but would be pleased to see how it is done elsewhere.

WALTER J. BITTERLICH.

Boston, Mass.

Drilling Fixture for Turret Lathe

In Fig. 1 is a double-ended terminal for use in electrical work. It is made



DRILLING FIXTURE FOR TURRET

THE PIECE DRILLED

from brass rod cut off and, the hole for the wire drilled eccentrically, as shown. This is done so as to allow more metal on one side for the threads in the drilled and tapped holes A, through which come set-screws for holding the wire in each end of the eccentrically drilled hole. These terminals had to be made in large quantities, so it was necessary to arrange for drilling and tapping the holes A quickly and cheaply.

To this end the rig shown in Fig. 2 was designed for use on a turret lathe. It consists of holder M, which is carried in the lathe chuck from the taper end shank. This piece M carries the movable part N, which is arranged to take the rod shown in Fig. 1, the wire hole of the terminal fitting over the pin P to insure the side with the most metal being outward. The terminal is held in by a small catch not shown at the top.

The holder N now has the holes for drilling through into the terminal; on a center line with these holes are the centering holes E, which are engaged by the spring catch at the center of M or the center of rotation of the lathe. So it will be seen that by pulling out the spring latch and sliding N across the center any one of the four holes can be brought to the center of the lathe and there drilled

and tapped by the lathe operator, who then stops his lathe and slides *N* along to the next hole.

By this little fixture one of these terminals can have its four holes drilled and tapped in about one minute, and a boy can operate the lathe. EGYPT.

Pittsburg, Penn.

A Babbitting Rig

We had to babbitt a large number of crank and gear cases for automobile motors and transmissions.. They are solid aluminum castings about five feet long and have seven bearings in line with each other, in which the crank-shaft and transmission shaft rotates.

We commenced to babbitt these bearings in the conventional manner, with a long babbitting arbor the full length of the case, supporting it with projecting fins resting on the top of the boxes, and put adjustable collars at each end of the boxes to prevent the babbitt from running out. Owing to the inaccessible location of the shaft deep in the crank-case and the very limited room allowed for the babbitt to run around the arbor, much trouble was experienced in getting a good job; when obtained, a great deal of chipping and filing was necessary to trim off the surplus babbitt level to the center line.

To overcome these defects, the rig illustrated in Figs. 1, 2 and 3 was made and has been working for some time in a highly satisfactory manner. Fig. 1 is a plan view of the fixture, Fig. 2 a cross-section, Fig. 3 a view through the center of the crank-case with the babbitting fixture in place.

With this rig we pour one box at a time and from the end, standing the crank-case upright. This insures the babbitt flowing all over and brings any defective material to the top and end instead of at the main wearing surface of the bearing.

The metal is poured through orifice *A*. After pouring, the handle *B* is given a jerk, revolving the collar *C* slightly and cutting the riser off flush with the end of the bearing; the cap screws *D*, which hold the fixture by means of the regular stud holes in the crank-case to the bearing, are then unscrewed and the fixture removed and placed on another bearing.

As the job produced requires no chipping, filing nor dressing, time and labor are saved and no trouble is experienced in getting a bearing full of babbitt every time.

Ossining, N. Y. BEN SPARKS.

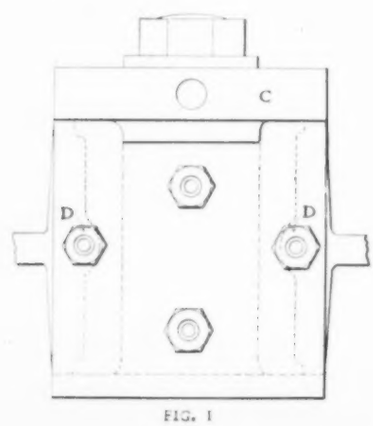


FIG. 1

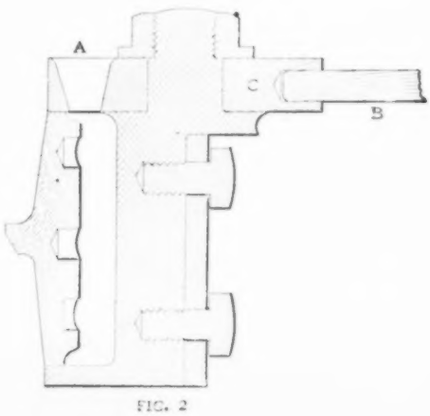


FIG. 2

A BABBITTING RIG

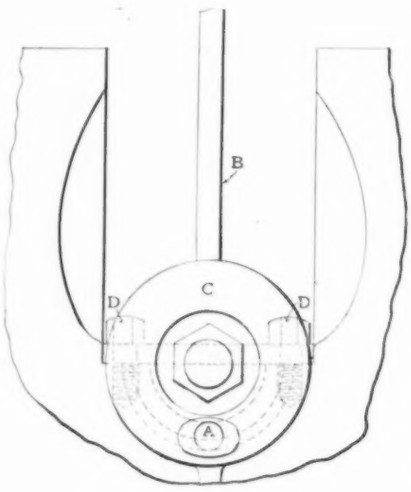
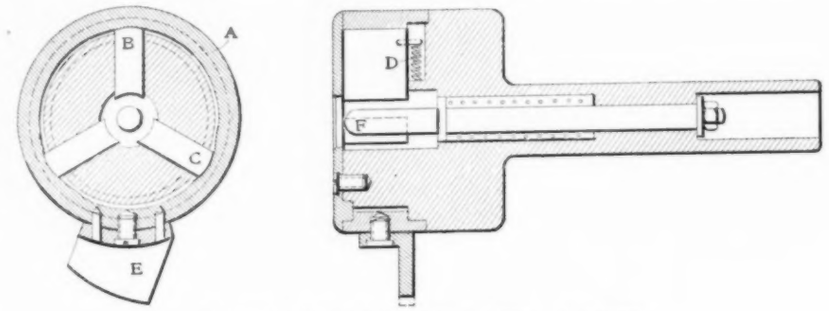


FIG. 3. THE RIG IN PLACE

An Automatic Chuck for a Screw Machine

On page 561 there is shown a semi-automatic chuck described by Carroll Ashley, which appears to be very good for the work required of it, that is, holding a piece while being operated upon by a revolving tool set in the spindle. However, it is often required to operate upon the opposite end of a piece, that is, the end nearest the cut-off tool. So we were compelled to devise some sort of a self-opening or closing chuck that would take the piece from the cut-off tool and carry it to a second spindle holding a die, drill or mill as the case might be.

Of course this attachment could not be used on the type of automatic having a turret whose axis is vertical, but on the Cleveland automatic turret machine it is a success. I recently saw a machine in Hungary with this attachment running on studs. It was making ¾-inch studs about 4½ inches in lengtth, threaded on both ends, at the rate of 600 per day of ten hours.



AN AUTOMATIC CHUCK FOR A SCREW MACHINE

The accompanying illustration shows a chuck or conveyer which we have designed for use on a new model Cleveland automatic with an adjustable head. The ring *A* is of hardened tool steel and is milled out so as to have a cam effect, as at *B*. The turning of the ring closes the jaws *C*. These jaws are bored in the chuck to the same size as the piece to be held, and are corrugated. When the chuck is empty, the springs *D* hold back the jaws. When the turret advances, the jaws pass over the revolving piece while open. At the end of the turret movement the piece is cut off. On the slide which carries the cut-off tool is a block. As the slide advances, the block pushes against the bracket *E* and closes the chuck. The plunger *F* has already been pushed back. The turret now recedes, the bar in the spindle feeds up ready for the box mill or forming tool and the turret indexes. The machine goes through its normal operations. The tool in the second spindle operates on the back end of the piece while some other operation is going on on the bar. A block is attached to the turret head so as to engage against the bracket *E* at *X* just as the turret indexes to bring the chuck once more in line with the piece being cut off, and throws the ring *A* back, opening the jaws and allowing the plunger *F* to throw out the finished piece.

Berlin, Germany. P. O. DODDER.

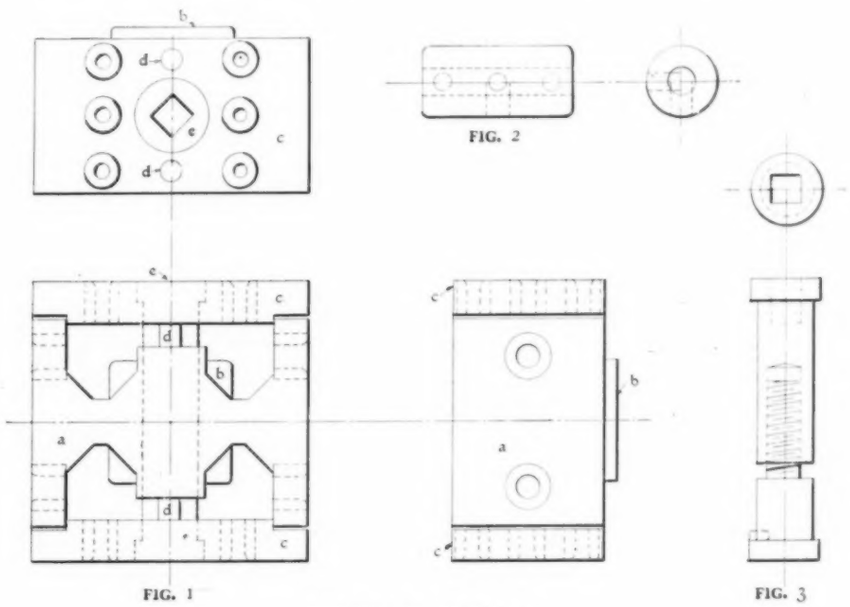
A Drill Jig

The half-tone, Fig. 4, and the line cuts, Figs. 1 and 3, illustrate a style of jig which may be of interest to those having a similar kind of work to do.

The central jig in Fig. 4 is the one shown in the line cuts and is for the piece of work shown at Fig. 2. This is a piece of brass rod, chamfered, drilled axially and cut off in the automatic screw machine. In it are to be drilled four holes, three spaced as shown, the fourth at 90 degrees and of a different size.

The jig may be described as a quadruple V-block surrounded by a clamping device and drill bushings. The body *a*, Fig. 1, is shaped as shown, to hold four pieces of work, one in each V. At one end of the jig is fastened a stop plate *b*, against which the work abuts. On the two open ends of the body *a* are fitted the clamping plates *c c*, which are held in position by dowel pins *d d* and also by projecting into the body as shown.

Passing through the center of the body *a* and clamping plates *c c*, is the clamping bolt *e*, shown in detail at Fig. 3. Its action will be apparent. Surrounding the four dowel pins *d*, but not shown, are spiral springs which force the clamping plates apart when the bolt is loosened. The arrangement of the drill bushings will be easily understood by referring to the line cuts and half-tone. Each clamping plate holds six bushings, while the bushings for the fourth hole are located in the body of the jig.



THE JIG AND THE WORK

In operation the jig is quickly filled, no time being lost in cleaning, as there is no place for chips to accumulate, and the four pieces are clamped by a turn of the bolt *e*. The wrench used in clamping is not shown, being of the familiar chuck-wrench style.

When the sixteen holes have been drilled, the jig is as easily emptied and gives a result about as near to continuous drilling as is possible on this class of work.

The two other jigs in the half-tone are for a piece of similar work but of different cross-section, the shape being such that a rectangular opening is required instead of a V. In these other pieces the axial hole did not extend through but was drilled a given depth in each end. One end was of course drilled in the automatic, and the drilling of the other end was accomplished in the jig by means of drill bushings inserted in the plate corresponding to the stop plate *b*, Fig. 1. This plate was made large enough to cover the whole face of the jig body.

The general arrangement of bushings and the appearance of the jigs will be seen in the half-tone. One of these jigs contains 24 bushings, as there were six holes to drill in each piece.

Waterville, Conn. RAYMOND GRANT.

Bolting Down Machine Tools

The article on page 957, Vol. 30, Part 2, about bolting down planers, reminds me of some experience I had on the same subject, which is perhaps a little out of the usual run of things.

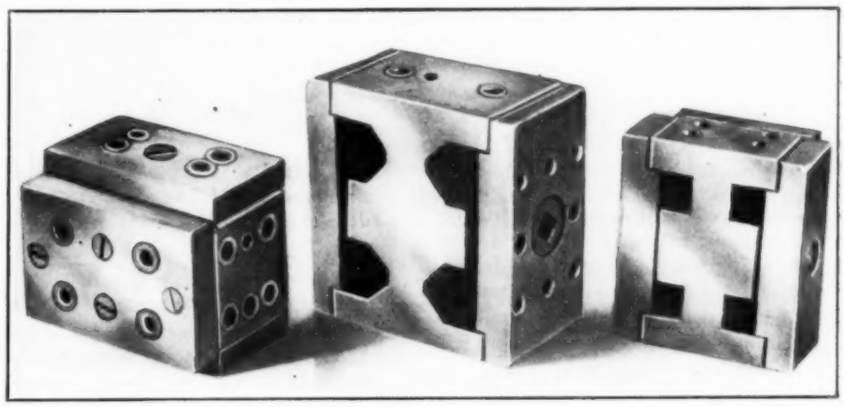


FIG. 4. THREE DRILL JIGS

We had just had a new automatic screw machine in, and were laying the foundations, when we found no provision had been made for foundation bolts; of course the hue and cry was raised, and the makers had a dressing down through the post the next morning.

However, we had a pacifying reply from them the day following, telling us that foundation bolts were quite unnecessary, they did not use them themselves on that particular machine, and advised us to try the machine without holding-down bolts.

We did so, with the utmost success, for we never had the slightest trouble with it moving.

We should probably have thought no more about the subject, had it not been for the local tax collector; the authorities were evidently hard up for money, and taxed every source of income the law allowed, a certain rate was levied on every machine in the shop, the tax man was usually pretty keen on each new machine, but he appeared to have completely overlooked our latest addition, but we subsequently found that he could only impose a tax on machinery *held down by bolts, or otherwise*. Well, this was an eye opener, and the next machine we bought we were wise enough to see that it had no holding-down bolts, in fact from that day very few new machines had, planers, millers, lathes, etc., simply had their own weight to keep them in place. I fully expected we should have to take some of them up and lay foundation bolts, but it was only on one or two light machines, running at high speeds that we had any trouble; in one case a small planer, when it had a heavy job bolted to it, seemed to move a little at the end of the return stroke, but we bolted a piece of angle iron down at

the back, so that it should still remain a machine not held down by bolts.

Some people may say, why not take up the bolts of existing machines; well, we were advised not to, as we might have been accused of evading the law, and perhaps have made matters a little uncomfortable, and we had at least one argument in our favor, viz., in some cases it is impossible to bolt some machines down, as no means is provided by the makers.

It is not usual for the authorities to tax each separate machine, but I believe they can do so in England; whether it applies to other places I do not know, but apart from this if it is unnecessary to bolt a machine down, then why do so. It saves the expense of laying foundation bolts, the machine can be fixed or removed without lifting it over the top of the projecting bolts, which is a consideration in the case of a three- or four-ton machine where there is no crane available, and the machine can be moved at any time to suit a countershaft, etc.

Judgment must be used as to which machine should be bolted down, and which not; as a rule a medium-sized machine, which is self contained, needs nothing more than its own weight to keep it in place, but machines like long gun lathes, or heavy machines which are not self contained, in some cases a bearing is separate from the rest of the machine, or the feed gear might be separate; in such cases the machine had better be bolted down, some light high-speed machinery too is as well held down by bolts.

Birmingham, England. D. E. D.

A Ball Chuck

Some time ago you published an article describing a ball chuck. The drawings show one which I designed and built for holding bottle molds while chipping the shoulder. It could also be used advantageously in die work.

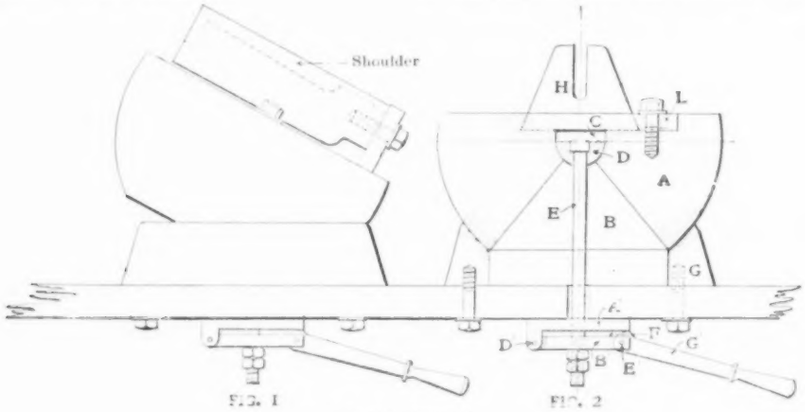


FIG. 1 FIG. 2

A BALL CHUCK

Fig. 1 shows the chuck tilted at an angle, with a half mold in place. Fig. 2 is a sectional view taken at right angles with the angle plate, and Fig. 3 shows some of the parts in detail.

Referring to Fig. 2, *A* is a spherical segment cored at *B* for clearance and at *C* to receive the half ball *D*, which is in turn cored to receive the head of the clamping bolt *E* passing down through the bench and cam-clamping device *F*.

Referring to the details of *F* shown in Fig. 3, *A'* and *B'* are respectively elevations of the upper and lower parts of the device, being drilled at *C'* for the clamping bolt *E* and at *D'* for a hinge pin. *B'* is also drilled at *E'* to receive a pin on which the cam lever *G'* works.

In operation the cam is thrown out and the ball tilted or revolved to the desired position; the cam is then thrown in. As *B'* is hinged to *A'*, it will be forced against the lock nuts on *E* by the action of the cam, drawing *A* down firmly into the cast-iron ring *G*, which is in turn held to the bench by three bolts. This method of clamping is quick and effective. *H* is an angle plate dovetailed into *A* and held in various positions (as the center of gravity may change when chucking larger or smaller molds) by the small gib clamp *L*.

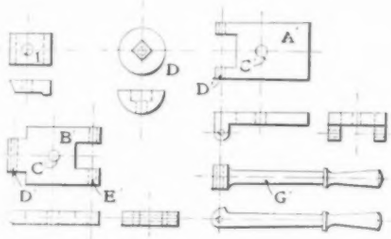


FIG. 3. DETAILS OF CLAMPING ARRANGEMENT

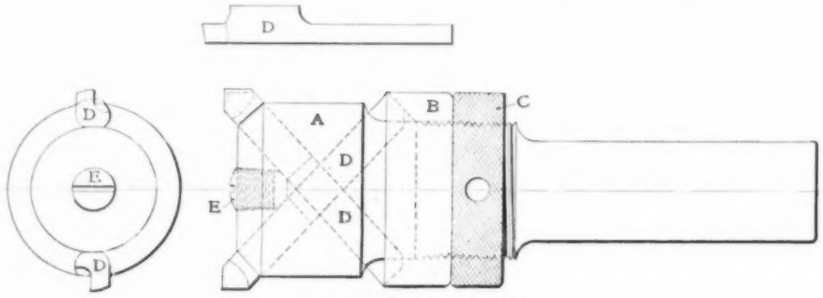
This chuck is comparatively inexpensive to make, as the only parts machined are the dovetail, angle plate and gib clamp.

CHAUNCEY T. KEEFER.

Los Angeles, Cal.

An Expanding Boring Tool

The illustration shows an expanding boring tool which I made for use in the turret lathe for boring a lot of brass bushes 2 inches bore, the holes being cored. The shank *A* is of mild steel, turned to fit the turret, threaded 14 threads per inch; for the nut *C* the collar *B* is bored a sliding fit over the thread and is case-hardened. The holes for the cutters are ⅜ inch diameter and cross each other. The cutters are made out of ⅜-inch round steel and are cut down to the center line, so as to cross each other as shown at *D*.



EXPANDING BORING TOOL

After the cutters are made and hardened, they are put in place and adjusted to a trifle over 2 inches and locked with the screw *E*. They are ground to size in a grinding machine and then backed off.

England. JAS. WHEELER.

Inspecting Tools with the Test Indicator

At page 773, Vol. 30, Part 2, Walter Gribben says in regard to testing a surface plate with the indicator described at page 537 that he thinks that if the plate were uniformly hollowing or a portion of a true concave sphere, the test indicator would read the same, regardless of what portion of the surface it might be applied to. I will assure Mr. Gribben that he is pretty nearly correct. In fact, in no part of my article do I claim to find errors on *true* surfaces ,whether straight, concave or convex; but the possibilities of finding true spherical concave or convex surface plates in existence seem somewhat remote to me. I will say, however, that in the test mentioned above the indicator will not only show waviness or winding, as mentioned by Mr. Gribben, but any deformity of any surface, especially such as may be caused by wear, which are the ones mostly aimed at in such a test.

In testing the lead of a threaded plug or tap, if Mr. Gribben will kindly look at Fig. 1 of the article in question, he will

note the ball point of the feeler, or attachment, and realize that when it is pushed into the V-groove of the thread it must stop when it has reached the two sides of the thread; consequently the transfer of hights at both extremities of the tap or plug to the hight gage occurs under similar conditions, thus showing the error in the lead, if any. In testing the lead of very fine threads, of course a V-shaped point is required on the feeler, with a slight flat on the nose, to assure a contact on the flank of the thread.

Beverly, Mass. J. H. BOULET.

Beat Tool for Clock Escapements —Micrometer Nuts for Pendulums

An uncle of mine has quite a number of clocks in various establishments that he maintains, and I have occasionally to overhaul the movements, oil them up and adjust them. One of the difficulties I encountered was to get the clocks "in beat," or to adjust things so that the distance *a*, Fig. 1, by which the pallet cleared the top of the scapewheel tooth at the end of the pendulum swing was the same for both pallets. If this is not so, and one pallet clears more than the other, the clock may go, but it is apt to stop under a very slight provocation. The usual way of performing this adjustment is to bend the "crutch" *b*, the small wire that connects the escapement to the pendulum.

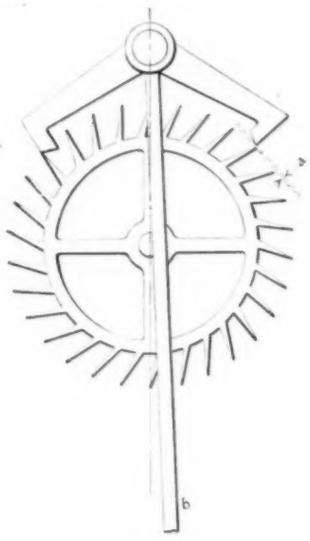


FIG. 1

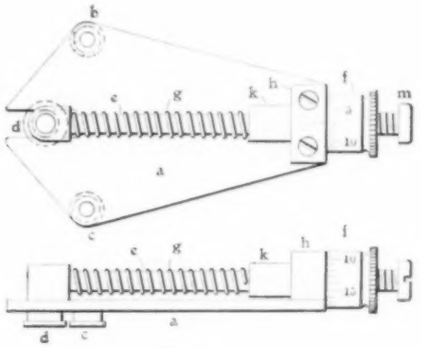


FIG. 2

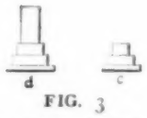


FIG. 3

BEAT TOOL FOR CLOCK ESCAPEMENTS

At first I bent this wire with my fingers, or a pair of pliers, but that is an uncertain operation, and I wanted something that would bend the wire a definite amount, so made the tool shown in Fig. 2. This works on the principle of a rail bender or shaft straightener, only on a very small scale. It consists of a sheet-steel plate *a* with the studs *b*, *c* and *d*; *b* and *c* being riveted in *a*, while *d* is riveted in the end of the threaded bar *e*, which is moved in one direction by the nut *f*, and in the other direction by the spring *g*. The bearing block *h* is secured by screws to *a*, and the loose sleeve *k* makes the tool work smoother, as it prevents the end coils of the spring from getting in the screw threads. The large-headed screw *m* is screwed tight into the end of *e*, and prevents the nut *f* from getting run clear off and lost. The plate *a* is slotted to allow stud *d* to play back and forth. Fig. 3 shows the studs *d* and *c* before riveting in. The bar *e* is threaded 40 per inch, and nut *f* has 25 divisions, which are read against a line drawn on *h*. This forms a micrometer to measure the movement of *d* in thousandths of an inch, although it is not necessary to read thousandths, or any other exact division of an inch for that matter.

After the clock is screwed fast to the wall, or is permanently placed, I see if the clock is "in beat" by taking hold of the pendulum bob and moving it over to the right so as to allow the right pallet to escape, and then move the pendulum back to its middle position. Of course, the next escape is to take place at the left pallet, so while watching the left pallet closely, I gently tap the pendulum toward the left, causing it to increase its swing by successively small amounts, until the escape finally takes place at the left pallet, when I stop tapping the pendulum. Now when the pendulum returns to the right, the escape may or may not take place at the right pallet. If it does not, it shows the right pallet meshes deeper than the left. If it does take place it shows the right pallet is not deeper than the left. In the latter case, I stop the pendulum just before the right escape is to take place, and gently tap the pendulum toward the right, watching the right pallet meanwhile. When the pendulum swing is increased just sufficient to cause the right pallet to escape, if this is not immediately followed by the left pallet escaping, then I know the left pallet meshes deeper than the right. I think this method of finding which pallet meshes deeper is better than judging by the sound, besides which the sound method would not do at all in my uncle's clocks, as his places of business are many of them very noisy, and it is impossible to even hear the clock beats, to say nothing of trying to draw fine distinctions between recurring sounds.

In case I find one pallet meshes deeper than the other, I apply the tool shown in Fig. 2 to the wire *b*, Fig. 1, in such a way that the studs *b* and *c* are on one side of the wire, while *d* is on the other side; also the micrometer nut must be toward the side of the clock on which the deeper pallet is located. Now I screw up the nut until the three studs grasp the wire tightly, and then turn two or three divisions beyond that point so as to slightly bend the wire. Taking note of the reading of nut *h*, I release the pressure, and take the tool off the wire, after which I try again to see which pallet is the deeper. If the same one, I apply the tool as before, only screwing it two divisions beyond its former reading, and then try the adjustment for beat again. When I get pretty close to the ideal condition I increase the reading of the nut *h* one division only after each trial. By repeating this process a sufficient number of times, it is an absolutely dead sure thing that the clock will be "in beat."

I never worked in a clock shop, but it seems to me there ought to be some bright mechanics or designers in some of them. Why is it that none of the ordinary commercial clocks have a micrometer nut on the bottom of the pendulum, and a mark on the pendulum bob to read against, the nut to be graduated in such a way as to read so many seconds per day in altering the rate of going of the clock? It is a comparatively easy thing to do, does not require to be done with any great degree of refinement, and enables the user of the clock to obtain much better service from it. Of course, the number of graduations on the nut is determined both by the fineness of the adjusting screw and also by the rapidity with which that particular pendulum vibrates. The method of determining this question is to square the number of swings that the pendulum makes in a half hour, multiply this by the constant 0.0003407 and divide by the number of threads per inch on the adjusting screw. This will give the number of seconds gained or lost in 24 hours for one complete turn of the nut. The reason for taking the number of beats in a half hour is because that is easily determined in a direct manner when the movement is taken apart for cleaning by multiplying together the number of teeth in the center wheel, the second wheel and the escape

wheel, and dividing by the number of teeth in the 'scape pinion and second pinion. In the formula the number of beats in an hour, or in a day, might just as well be used, but, of course, the constant would then have to be different. On a one second's pendulum with an 18 per inch screw, the formula figures out that one turn of the nut makes a difference of between 61 and 62 seconds per day in the rate of going of the clock. In this case it would be safe to graduate the nut into 12 parts and say one division produced a difference of 5 seconds per day in the rate, which would not be strictly true, but near enough for practical purposes, and much nearer than guessing at it. Or, if the nut was large enough in diameter, there might be 30 divisions, each one producing a difference of 2 seconds per day.

Many clocks have inside the case printed instructions for regulating the clock, but none that I ever saw gave the user any idea of how much to turn the nut to produce a required result. It seems to me a very simple matter to incorporate in these instructions just what result is to be expected on turning the nut a stated amount, say, for one complete turn, if the maker does not care to graduate the nut.

Brooklyn, N. Y. WALTER GRIBBEN.

Automatic Lift-out for Punch Press

The removing device for shells shown in the accompanying drawings is used in connection with a compound piercing, blanking and forming die, to remove the finished product and throw it through a chute into a barrel behind the press. Fig. 1 is a side elevation and shows the device in relation to the die. Fig. 2 shows the plan of the finger, and Fig. 3 gives us a rear view.

A double lever *A* pivoted in the stand *B* is connected by a shoe *C*, slidable on the rod *D*, with a finger *E*, which rests with one side on the die. A stud which carries the roller *F* is fastened into the stand. When the rod *G*, which is attached to the rear of the ram is moving upward, the shoe *C* will travel toward the die and place the finger underneath the shell *S*. By the end of this movement the cam-formed end of the finger *E* will come against the roller *F*, which will swing the finger over in a position, as shown in dotted lines, taking with it the shell. In the middle of the finger is a piece of wood which gives the shell the proper direction to drop it safely into the barrel.

Montreal, Canada. G. K.

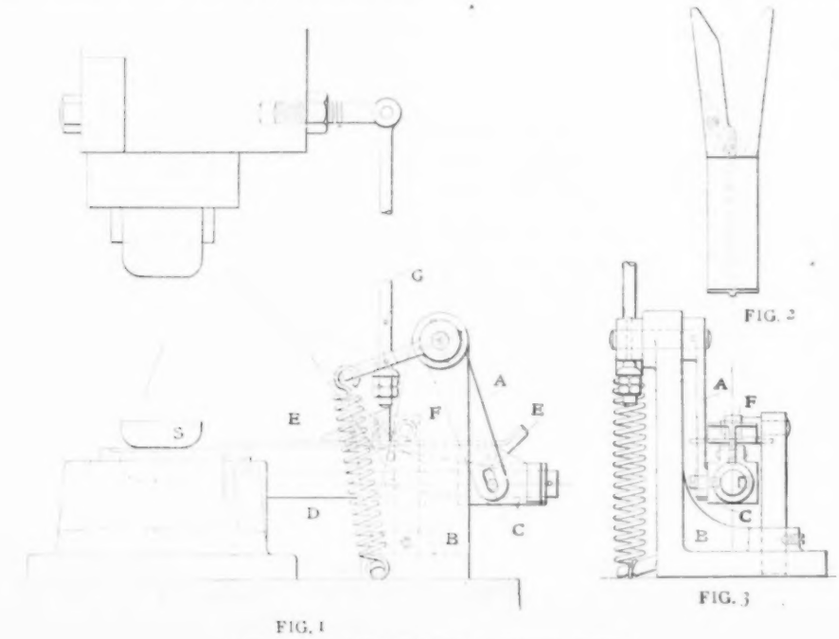


FIG. 1

AUTOMATIC LIFT-OUT FOR A PUNCH PRESS

FIG. 2 FIG. 3

Fixtures for Turning and Facing Tool-holder Clamp Bushings

We have a great number of bushings for clamping tool holders in the turrets on vertical boring mills. I have these bushings bored and reamed on the chucking machine to ¾ inch, being careful that the reamer is cutting very close to size. They are then taken to the lathe and finished. The pattern number C3-85 is cast on the bushing simply to distinguish the casting, but I took advantage of it and used it in place of lugs for the driver to work against.

Fig. 1 is made of machine steel, bored and threaded to fit the nose of the lathe spindle. It is then turned on the spindle, in the place it works, to the dimensions

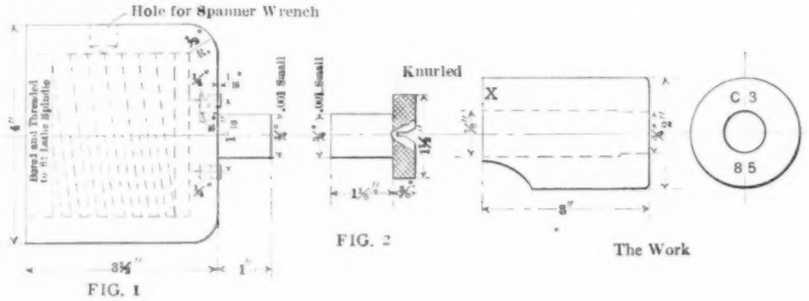


FIG. 1 FIG. 2 The Work

FIG. 3

FIXTURE FOR TURNING CLAMP BUSHINGS

given on the drawing, after which it is drilled to allow two ¼-inch hardened-steel pins to be driven, which act as the drivers.

Fig. 2 is a tool-steel plug turned, hardened and ground with an extra-large center in the nurled end.

Fig. 3 has a body of machine steel with the taper turned to fit the center hole in the lathe spindle; the front end is bored to allow the cast-iron bushing *A* to be a neat fit. The outside is turned and threaded to allow the machine-steel nose *C* to be screwed on. The cast-iron bushing *A* is turned taper about 5 degrees on the end projecting from the body *B*, after which it is split as shown. The nose *C* is screwed in place and bored taper 5 degrees and to the size which allows it to grip *A* and close it.

The plug, Fig. 2, is put in the end of the work *X* and the work is put on the nose of Fig. 1. The tailstock center is then brought up into the center in Fig. 2, which holds it up in place while the hard-

ened pins in Fig. 2 engage with the letters C3-85 and drive the work, which is turned to the required diameter. I have two plugs like Fig. 2, so that the operator can get one piece ready to put in while the other is cutting. Fig. 3 is put on the lathe for the operation of facing the ends and boring the relief in the work.

This does not make the bushings exactly true, but it brings them within the limit allowed; as the bushing takes the bearing on the outside diameter with clearance between hole and stud, the saving of time over the old way, of putting on and off a mandrel, means more than the accuracy of the old way.

Oil City, Penn. E. I. PHIPPS.

A Test Indicator

Herewith is illustrated a test indicator. It will be seen by the views shown that the device has a very large number of applications and it is a simple instrument that a good machinist can make; it is a fine tool to possess.

Fig. 1 shows the indicator. It consists of a main body with two holes at right angles; a plunger in contact with the short arm of the indicating needle; a clamping thumb-screw nut. It will be noticed that the general line of plunger motion being in the same axial line as the frame of the indicator, the instrument can be placed readily by the eye at right angles to the work that is to be tested, giving a positive right-angular motion to the plunger, essential to an indicator for obtaining an accurate reading.

Fig. 2 shows the opposite leg of the testing caliper for calipering or testing the parallelism of anything within its range as shown in Fig. 7.

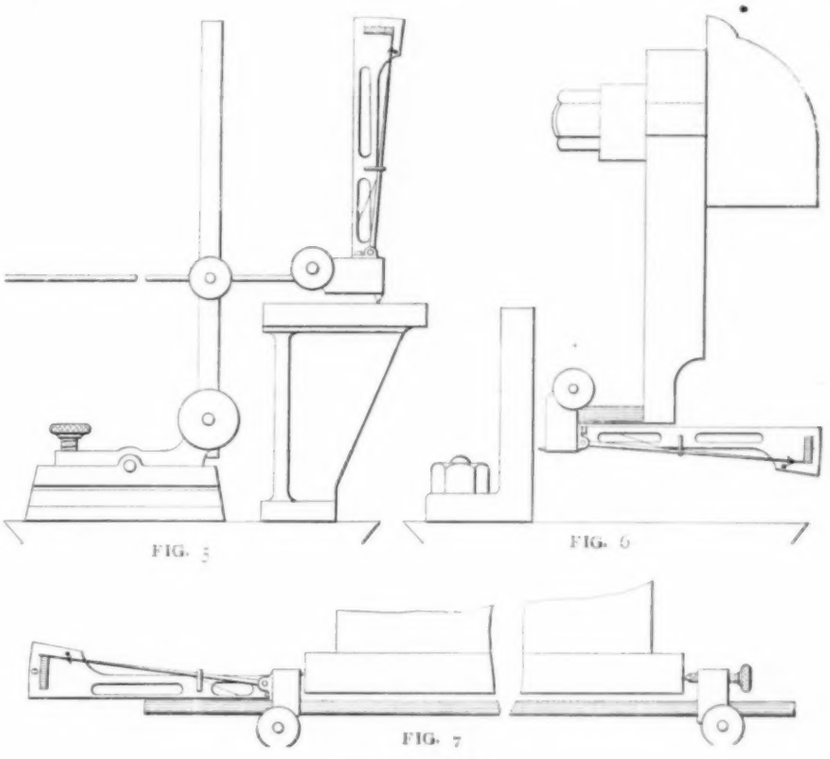
The connecting rod can be of various lengths, 12, 18 or 20 inches, making a handy and accurate device for the testing and comparison of work gages. In this combination of the indicator it can be likened to a comparator; for instance, as in Fig. 7, a length gage can be placed between the plunger point and the opposite adjusting-screw point and the needle brought to zero.

For many jobs the device is far ahead of verniers for finding out just where you are at. For comparing large dimensions this indicator is an efficient and rapid time saver. With the indicator arranged as in Fig. 7 an instantaneous reading is noted showing the variation in thousandths.

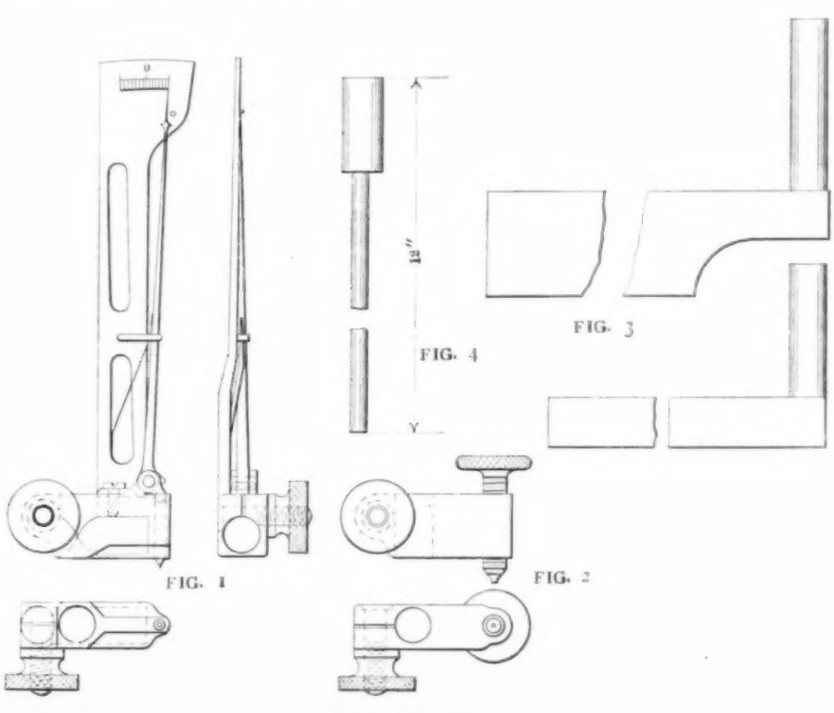
Fig. 3 is the indicator holder for the lathe, slotter, milling machine, or any tool post. The small holder can be used in small tool posts, or any place with the pin vertical or horizontal. Fig. 4 shows the extension enabling the indicator to be used in combination with the surface gage Fig. 5. A 12- or 18-inch Starrett surface gage used with this indicator makes a splendid combination.

Fig. 6 shows the indicator used for testing, or squaring plates on the slotter or milling machine.

Brighton, Mass. F. RATTEK.



TEST INDICATOR



TEST INDICATOR

Sulphur as a Lubricant

The article by A. N. Hammond reminds me that sulphur as a lubricant is used as a last resort at sea for hot guides. I have seen it used many times in many ships and have mentioned it as a lubricant to several people on shore who have had trouble with hot bearings, only to be sneered at.

Where sulphur was available I have never had to stop at sea because of a hot guide or bearing. We used it in the powdered form mixed with oil.

New York. E. A. DIXIE.

Press Tools for Hollow Balls

I propose to show how these are made in England, and having introduced some improvements in the method of drawing the cups, special attention is directed to No. 3 punch and die which draws and trims the cup at one operation. I have found this a success, but must emphasize the importance of all tools being properly ground on the universal grinder. If this is carried out a perfect ball with a clean hole is the result. I show full size sectional diagrams of dies for a 1-inch ball; all sizes down to ¼ inch are made in a similar manner; below that size they are generally used by jewelers, so will not interest the machinist. The stock is No. 16 metal gage, so being rather thick no pressure plate is needed for the first operation as the blank draws without wrinkling. The length of cup after passing No. 3 die is exactly 1¼ inches long; this is insured by making the punch 1¼ inches from the bottom to the step *a*, less the thickness of the metal. It is turned and ground taper about 1 degree so that the cup will easily drop from the punch *P* on the return stroke of the press. The drawing of these cups will be best done on a long stroke press. I use Bliss's, although no doubt other makes are suitable. A steel plate is arranged on the top of the die shown at *b*, Fig. 7; this strips the scrap from the punch and should leave a smooth cup ready for the closing dies, and as the cups are all exactly the same length and the holes in the finished balls are all the same size which is a great advantage.

After the cups are drawn they are passed through No. 4, in which the top and bottom dies are of the same section, then No. 5, and, lastly, No. 6. This operation is best performed on a foot press, as several blows are required to thoroughly round the ball.

These tools are intended for balls in brass, german silver, copper, etc., but not steel, and annealing must take place after each operation. No. 1 may be cut and cupped at one operation if a double-action press is at hand, No. 2 fed automatically by circular feed, No. 3 ditto, Nos. 4 and 5 in a power or foot press, and No. 6 preferably in a foot press. Thus a ball is made from a blank in six operations.

Sheffield, England. O. CLERK.

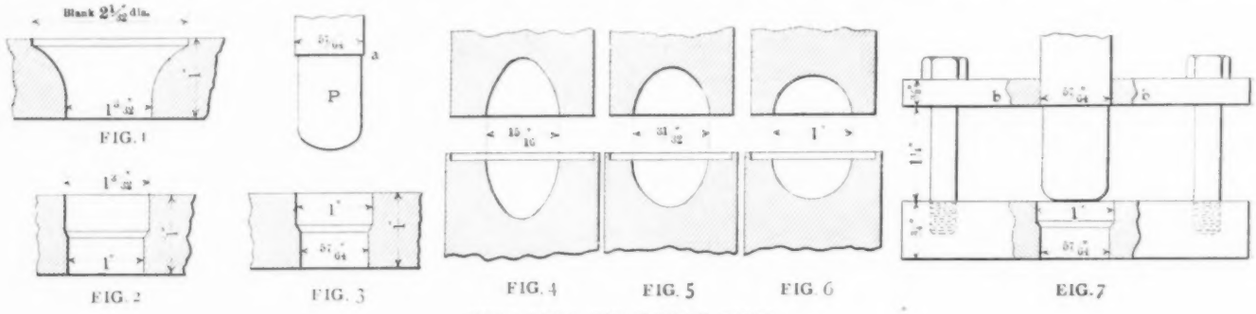


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6 FIG. 7

PRESS TOOLS FOR HOLLOW BALLS

Checking Drawings

Believing as I do that criticism is healthy in all trades, I was glad to read Mr. Allen's article on page 59, which was written in answer to a previous article of mine. Because the scheme I outlined works well, and anything that does so is good, also because the checking of drawings is a very important branch of mechanical practice, I am tempted to reply and further explain a few of the points to which Mr. Allen takes exception.

In the first place he asserts that a checker should check the figures and not the design. The exact duties of a checker cannot be controlled by any hard and fast rules; you have to take into consideration the grade of man, the type and experience of the draftsmen employed, and of course the rules of the office. Some firms are content to install a checker who is merely a good mathematician, with a knowledge of projection; in this case, of course, he could not be expected to do more than look after the accuracy of the figuring and method of drawing. Other concerns, however, think it necessary to fill the position with a man who can look at the work from a practical point of view, as well as a theoretical standpoint; in other words, a man who not only shows an aptitude for figuring, but who has worked in machine shop and drafting room on the type of work he has to check. In an office where suggestions are invited from everyone, would not this checker, when going through a drawing, naturally look to see where a drawing might be improved. Also Mr. Allen will readily see that a man with this experience, continually dealing with the design of a number of draftsmen on a certain type of work, must necessarily become familiar with the requirements thereof and therefore particularly fitted to suggest improvements. Secondly, Mr. Allen took exception to the fact that I check the tracings instead of the drawings. I consider that I have good reason for doing this; it is the print from this tracing which is issued to the shops and therefore I am interested in that alone, and instead of taking a circuitous route through the drawing, I go to the tracing direct. Ninety-five per cent. of the changes called for are in figures which are as easy to change on the tracings, as on the drawing. Very rarely is a radical change of design called for after the drawing is made, since the chief tool designer naturally keeps track of all drawings in progress. Another point is, and I have noticed that the more ingenious a man is the more pronounced it becomes, many designers make a very rough drawing, to properly check which would be much more difficult than to check the tracing.

As regards submitting drawings to a committee after they are finished, would it not be expedient to consult those interested before the drawings are started, and get the benefit of their ideas in the first place?

Detroit, Mich. CHARLES F. HOWSE.

Contraction of Steel in Hardening

Reading the lengthy article "Expansion and Contraction of Carbon Steel in Hardening," page 932, I notice that the author seems to lay great stress upon knowledge of the use of and skill in the manipulation of the micrometer for measurements in distortion of carbon steel. I agree with him upon this point. I also concur in his opinion that the tempering and tool rooms should never be two distinct departments, and I consider that the artisan that makes the tool ought to be able to do his own hardening.

In reference to the action of steel, I never found it so varied and peculiar; in any case, the treatment is only in getting it to the proper heat at which it will temper. I have always made it a practice to try a piece of steel to get the heat at which it will give the best results in tempering and I assure the readers that I never miss. It is always best to test any brand of steel, to be well acquainted with how to handle and manipulate it at the exact and lowest heat it will temper with the best results. I have no doubt that the manufacturers of carbon steel will tell you the same. I have never tried to temper ordinary carbon steel with any number of degrees of heat, as the writer of the article mentioned enumerates. This seems to me a waste of time. I have always heated steel at the proper, lowest heat it will take a good temper, and I have used only good, careful common sense irrespective of any red tape. Above all, experience and good

judgment are the preëminent factors in all cases.

The writer quoted makes the assertion that "steel does expand." He also states, "plugs that are longer than their diameter by at least one-half will almost invariably swell in diameter and shorten in length if hardened." Another statement is that "when the length and diameter are nearly the same, it being a cube, both expand." The statements contradict one another, it seems to me; from my experience it undecidedly contracts both ways.

It is strange that we all differ so materially, and I have no doubt but that the writer is just as sincere as I am. In conclusion I would state that it seems that with some the material grows and with some it is the opposite. These articles are very interesting and instructive reading, by which we all benefit. I would be glad to hear from the readers real solid facts as to actual distortion of steel.

Louisville, Ky. HERMAN FLETCHER.

A Circular Forming-cutter Problem

I recently had to make some forming cutters for roughing out some pinion staffs from the steel wire, the end of the staffs to be pointed at 60-degree angle, and as the points were used as centers on which to finish the work, they had to be pretty nearly right.

The cutters were 2 inches in diameter

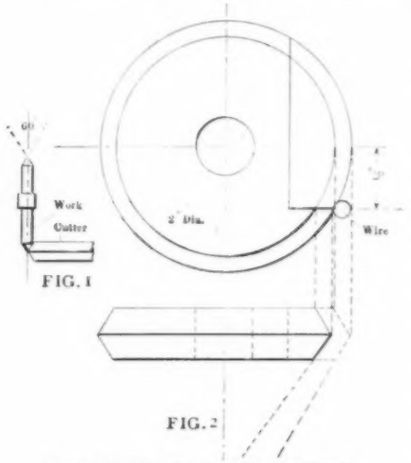


FIG. 1

FIG. 2

THE CIRCULAR FORMING CUTTER

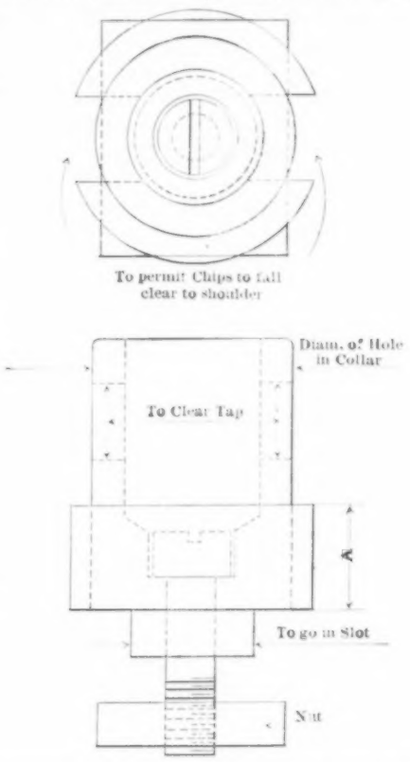
and the cutting point was ½ inch below the center of the cutter, so in order to make the points on the work 60 degrees the angle on the cutter had to be much greater on account of getting below center.

I should like to ask your readers if they can give a method for figuring this out? The only way I was able to obtain it was to lay it out on paper to a large scale and measure the required angle with a protractor. As this is a very crude way for obtaining accurate results, I should like to know of a better one. I. G. OWEN.

Indianapolis, Ind.

Drilling and Tapping Collars on the Lathe

The line cuts show a fixture for drilling and tapping collars; it needs very little description. It is cheap to make, effective and economical in operation, and is used



FIXTURE FOR DRILLING AND TAPPING COLLARS

on a lathe with a rise and fall rest. Very little accuracy need be exercised in its making.

If the lathe has no rise and fall, then the distance at *A* should be right to locate the hole central with the lathe centers. The fixture is held in the tool slide and is fastened in by aid of a fillister-head screw and any piece of flat stock that will enter the slot and not turn, to form a nut. It is economical because no clamping of the collar to be drilled is necessary, as gravity and the weight of the hand will hold it in position. The drill and tap are held in the lathe chuck, and they will center themselves in the work.

Lansing, Mich. G. ALLEN.

Removable Bushings

A. J. Baker, in his article at page 101, presents what he calls a very satisfactory and economical way of standardizing bushings. I do not agree with Mr. Baker in making up large quantities of jig bushings, whether they be removable or stationary for the simple reason that it is seldom that one finds two pieces alike, and as it is always advisable and wise policy to have the bushings close to the work, any variation in the hight of the work would necessitate variation in the length of the bushing, provided the same tool pattern could be used for several parts, which is frequently the case.

Again, he gives the diameter *C* of the head of the removable bushing, the same as the outside diameter *D* of the liner. Now if the drill by mistake comes down on the top of the removable bushing, the result would be that one could force the liner bushing out of the jig as well as force the removable bushing after it.

I would therefore suggest leaving out of the table the length *B* of the removable bushing and increasing in all instances the diameter *C* of the head by 1/16 inch.

Buffalo, N. Y. LUCIAN HAAS.

The Design of Links

As I have seen many machine links that give more or less trouble I thought it might interest some readers to know of the link adopted by the Cincinnati Planer Company, Cincinnati, Ohio, after several severe tests with various kinds of metal and construction.

The link shown in Fig. 2 is a typical example of the usual design of such links. It has the two great faults of being too easily broken if made of malleable iron, and too easily bent if forged of steel. Fig. 1 shows the link adopted. It consists of a U-shaped section and is made of malleable iron. The best results were obtained by making the metal about 3/16 to ¼ inch thick. When the metal is much thicker than this it becomes brittle in the interior, and only the outside shell is really malleable iron. By making the link of the section shown in Fig. 1 good metal is obtained throughout,

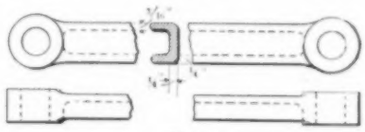


FIG. 1

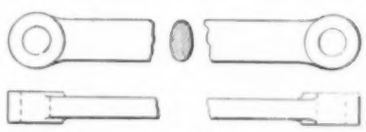


FIG. 2

TWO TYPES OF LINKS

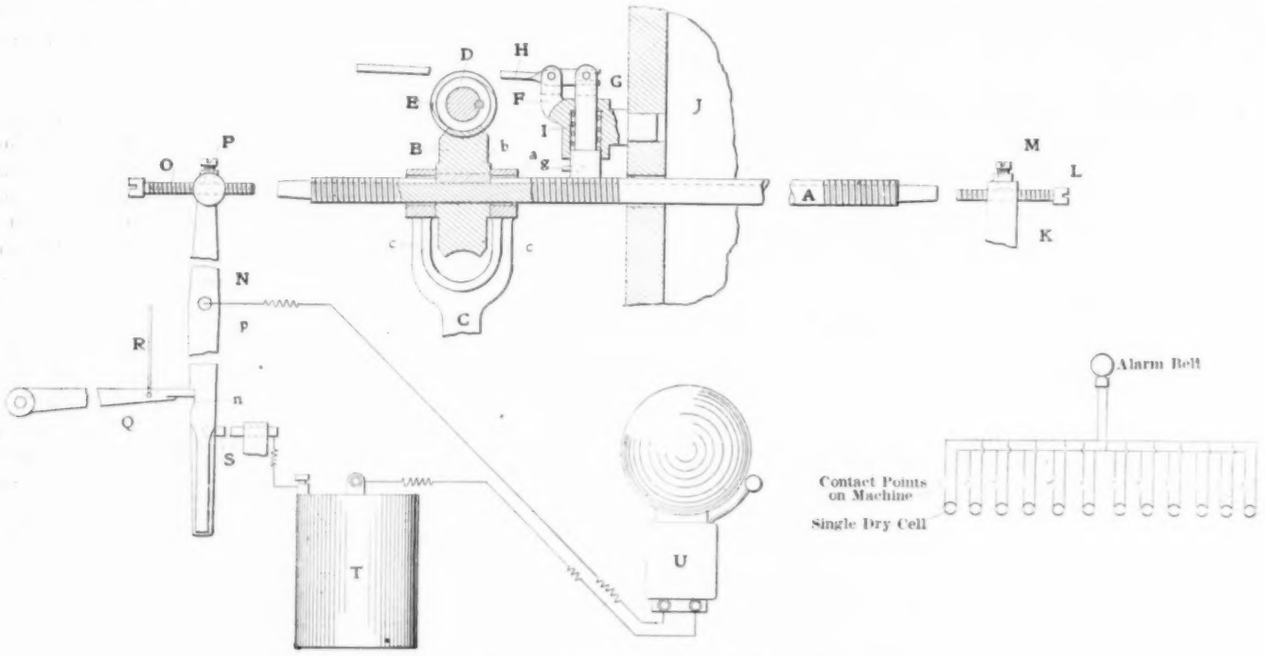
and at the same time the link is stiff on account of the bracing action of the side ribs.

It is undoubtedly true that there is a side bending stress on such links unless the studs are supported on both ends. The section of Fig. 2 has very little resistance to such a side stress; but with the section shown in Fig. 1 the side ribs give the link sufficient strength to resist it. Where the links have a bending pressure in any other direction they can be further stiffened by cross ribs put in to counteract it. HOWARD W. HUNT.

Cincinnati, Ohio.

Positive Stops and Tell Tales for Machines

The accompanying illustration and description will serve to illustrate a fixture used in a shop in which I was at one time employed. The object of the device was to provide a positive stop for a series of automatic roughing-out machines. These machines roughed out pieces from round bar stock, which was furnished in lengths of about three feet. One man had charge of 10 or 12 of these machines; often when his back was turned one of them would cough up the fag end of a bar, and then go on cutting air until he happened to notice the state of affairs. It was to remedy this evil propensity that the device was designed.



POSITIVE STOPS AND TELL TALES FOR MACHINES

A is a long bar of tool steel, having a thread cut on it from one end to the other, of any convenient pitch, and the ends turned down to form shoulders and hardened. This bar has a keyway *a* cut in it to accommodate the key *b* in the worm wheel *B*. This worm wheel is supported by the bar *A* and is held between the forks *c c* of the bracket *C*. The key *b* fits tightly in the worm wheel *B*, but is an easy running fit in the keyway *a* of the bar *A*. The worm wheel *B* meshes with the worm *D*, which is keyed to the shaft *E*, this shaft being a part of the original machine. *F* is a small steel forging, shaped as shown in the sketch, and accommodates the plunger *G* and the lifting lever *H*. The plunger *G* has at its lower end an enlargement in which are cut screw threads meshing with those of the bar *A*. The forging *F* is drilled out to form a chamber for the spring *I*, and has a small slotted lug in which is pivoted the lifting lever *H*, which is merely a piece of flat steel slotted at one end to accommodate the pin in the upper end of the plunger *G* as shown, and spoon-handled at the other end. *J* is a part of the frame of the machine to which *F* is fastened by being driven tightly into a hole drilled for its reception. *K* is a solid stop screwed to the machine bed, and carries an adjustable stop screw *L*, against which the end of the bar *A* abuts, as will be explained later. *M* is merely a binder for *L*. *N* is a flat bar of steel carrying an adjustable stop screw *O* and binder *P*, and is pivoted at *p* to another part of the machine frame. The bar *N* has a notch *n* which accommodates the end of the lever *Q*. This lever is pivoted underneath the machine, and carries the treadle wire *R*, which is connected to the belt shipper in the usual manner. The end of the bar *N* is rounded slightly at the lower end to afford a hand grip, in case it is necessary to stop the machine by hand.

The operation of the device is as follows: After the bar of stock has been placed in the machine and all is in readiness for work, the lever *H* is depressed, thus raising the plunger *G* out of engagement with the bar *A*, which is then pushed back (to the right in the drawing) until it banks against the screw *L*, which has previously been set approximately correct. The operator next releases the pressure from *H*, whereupon the spring *I* forces *G* down upon *A*, bringing them into mesh. He next presses down *Q* until he can catch the end of it in the notch *n* of the bar *N*. This throws the belt shipper in the usual manner and starts the machine. The shaft *E*, being one of the parts of the machine, begins to rotate, carrying the worm *D* with it, thus causing the worm wheel *B* and the bar *A* to turn. As *A* is rotated, the threads meshing with those in the plunger *G* cause it to move forward (to the left in the drawing) until the end comes in contact with the screw *O*, pushing it back until *Q* is released from the notch in *N*, which allows the belt shipper to fly back, thus stopping the machine. A fresh length of stock having been put in position, the operation was repeated as often as desired. By manipulating the stop screws *L* and *O* it was possible to use the stock up to the last piece without waste. The lower end of the plunger *G* was chamfered slightly to prevent the edges of the keyway in *A* from catching on it as the bar *A* rotated. The pin *g* merely limited the upward travel of *G*.

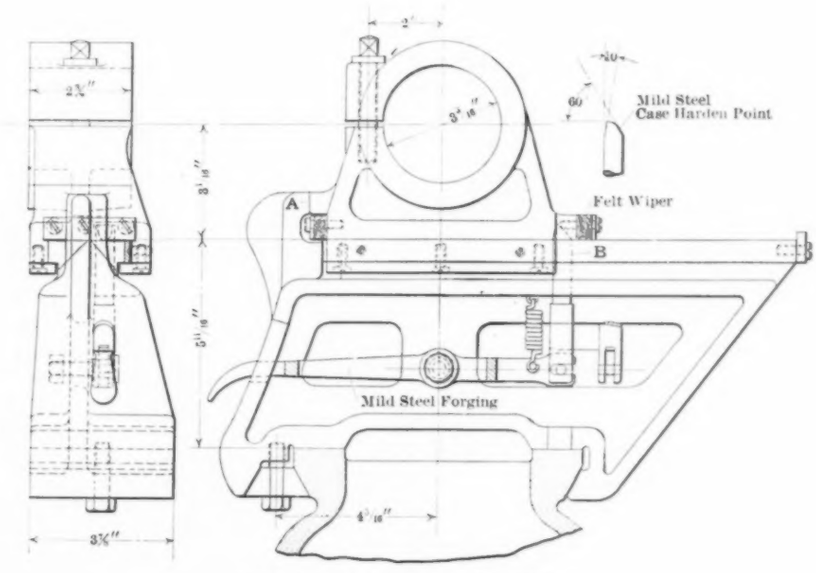
The device worked like a charm for a long time; the operator could hear the click of the lever when released and thus could tell when any of the machines stopped, until the company installed next to the roughers some ill-bred machines that were eminently qualified for first place in a Fourth of July celebration. Then the foreman put in an electrical attachment similar to the one shown in the sketch, consisting of a couple of contact points *S S*, a dry cell *T*, and a small alarm bell *U*, after which there was no more trouble. When the bar *N* was pushed into release position, the two contact points *S S* came together, thus establishing a circuit and ringing the bell, which was loud enough to be heard above the noise of the machine. One alarm bell sufficed for the complete series of roughers, the wiring, cells, etc., being arranged as shown in the sketch.

F. W. B.

Chicago, Ill.

Drill Support for Chucking Machine

The accompanying sketch illustrates a type of drill steady which we have made and adopted for the chucking machines and which has given satisfactory results. As will be seen, the head carrying the various sizes of bushings to suit the drills is mounted on a sliding frame, which is fastened to the machine bed by means of the angular strap shown and the locating face on the opposite side, and which can be readily moved about to suit the different lengths of work. The head is also made to slide and is located in position at the two finished spots *A* and locked by the spring plunger *B*, which is operated by the hand lever which passes through a slot in the front of the frame. When the work has been drilled the plunger is released, and the head is pushed back to the stop at the rear end of the frame, for the reaming and facing operations, and is then in such a position as to clear the reamer and long drill which have just been used, standing as it does in the angular space between the two tools, and allowing the turret to be brought up close to the work. The dirt and chips are wiped off the slide by two felt pads, which extend a little over each side, and are held in position by the steel plates and screws,



DRILL SUPPORT FOR TURRET LATHE

and by tightening these screws the pads can be made to spread, when showing signs of wear. A portion of the front end of the slide is cut away to an inverted V-shape, to allow the chips to fall off readily, when the head is brought forward into position. The drill steady here shown is attached to a Brown & Sharpe chucking machine.

Birmingham, England. A. M. PECK.

Method for Locking Connecting Links in the Rims of Split Wheels

In Figs. 1 and 2 is shown a simple and positive method for locking the connecting links in the rims of split wheels. The links are shrunk in place in the usual manner and with the springs and pins *x* inserted in the links in their proper place. When the link reaches the proper depth, the pins *x* are forced out by the spring *s* into the holes *k* and lock the link in its position. To remove the link, force pins *x* into the link through holes *k* and lift the link out.

The thickness *T* of the link is given by the following formula when the area is known,

$$T = \sqrt{\frac{\text{area}}{1.5}}.$$

The other proportions are based upon the unit *T*.

Ansonia, Conn. BENJ. BROWNSTEIN.

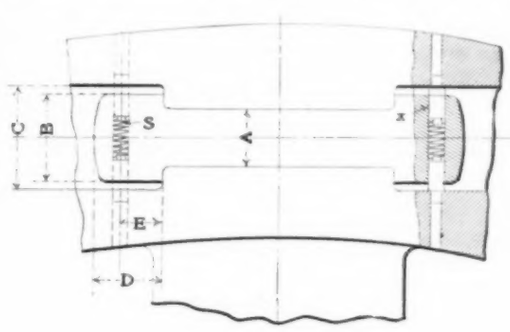


FIG. 1

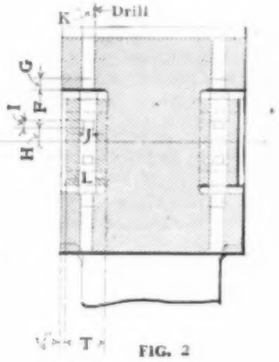


FIG. 2

A	1.5 T.	D	1.7 T.	G	.3 T.	J	.3 T.
B	2.14 T.	E	1.1 T.	H	1. T.	K	.36 T.
C	2.6 T.	F	1.4 T.	I	.07 T.	L	.43 T.

METHOD FOR LOCKING CONNECTING LINKS IN THE RIMS OF SPLIT WHEELS

Why Planers Should Be Bolted Down

On page 957, Vol. 30, Mr. Norton asks, "Why should planers be bolted down?" I do not propose getting into an argument on the subject, but will say to Mr. Norton that while I believe with him that the modern planer, resting upon a solid foundation with adjusting arrangements, needs no bolts, there are many concerns who are obliged to locate their planers on the second, third and fourth floors of their factories.

Many times the planer is placed on the floor, with no foundation except the floor on which it rests. The floors are not always level and the planer legs need to be wedged up to bring the planer ways level. These floors are not always firm, and there is more or less tremble or jar present. If the wedges are not held in place by something more than the weight of the planer, they are liable to jar out. When this happens, the planer is sure to crawl more or less.

I well remember a row of planers on the third floor of the factory where I served my apprenticeship. The floor was somewhat uneven and we had to pack the feet of the planers to bring the table level. When the bolts were left out, those planers would move a quarter of an inch or more every time they reversed. One of these machines had no holes in the feet, and I remember that we used to drive a row of nails around the outside of the feet to keep the planer from dancing back and forth.

I presume that the planer builders have these facts in mind when they send out their planers with holes for bolts in the feet; although it may not be actually necessary to bolt the planer down. The momentum of a reversing planer table may not always affect the position of the bed on the floor, but with some makes of planers I know it will do so.

Taunton, Mass. CHAS. F. LOGAN.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

During 1907 *we printed and circulated* 1,151,500 *copies of the* AMERICAN MACHINIST. *Our circulation for February,* 1908, *was (weekly, monthly and European)* 93,750.

Mar. 5..... 36,750
Mar. 12..... 19,500
Mar. 19..... 19,500

This paper reaches 36,750 *separate readers each month and* 19,500 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Shorter Life of Machine Tools

Makers of machine tools are familiar with the criticism that comes from users of their tools, especially from shops that have long years behind them and where the managers have grown gray in the service, that the newer tools are shorter lived than those which were built 20 to 40 years ago. And sure enough we often find lathes that have been in use for 15 years in fully as good condition as one of the newer high-speed lathes that has been running perhaps 5 years.

But there's a reason, as the advertising man puts it; and it isn't in the deterioration of either material or workmanship, either.

We too often overlook the fact that we run machinery very much faster than formerly, that the old cutting speed of 16 to 20 feet has increased to 60 and 100, sometimes higher, that cuts and feeds are heavier and that we are turning out much more work than ever before for a given number of men, of machines and of floor space occupied.

And this is what wears out the machinery so much faster than before. The higher speeds tell on the various parts such as speed and feed boxes, bearings and ways. Gears wear out more quickly as a matter of course, and it is clearly to the interest of all concerned to have them as good as it is possible to make them commercially, as the failure of a small and inexpensive gear may tie up the whole machine so as to cost more than if it had been made of gold and had kept at work.

These points are of much more importance on machine tools than ever before, as more is expected of them in every way. Buyers should not forget that tools run at a high speed are bound to wear out faster than those which run slowly. They must decide for themselves whether the increased production will more than make up for the decreased length of service, and not complain because gears wear out faster than they did when speeds were slower.

Specific Knowledge as an Asset

It is considered a good principle of manufacturing to have the same workman do the same job time after time as it recurs. By so doing the workman gains much specific knowledge about that particular work. Do we realize that this knowledge is an asset to his employer as well as to him personally?

There are many cases where a workman knows more about the details of the tools and the details of the operations than his foreman. If he is a good workman and has performed the job many times, he knows that perhaps a set of milling cutters intended for some other job is just right for some operation on the one which he is handling. He knows that such a jig or fixture is a little out of true and needs papering up a few thousandths on one corner, or he knows that by performing such an operation before one which might naturally precede it a direct saving in time is made. These facts, kinks they have been called, are an asset to him. He can produce that job more quickly and more cheaply than probably any other man in his department; not because of superior ability but because of specific knowledge. Therefore the recurrence of that job has a personal money advantage to him, and the fact that he can produce it more cheaply and quickly is an asset to his employer. This fact should not be overlooked when the time comes for laying off men; and a workman should not lose sight of the fact that if he changes his place of employment, he loses the advantage of what he knows about the particular line of work on which he has been engaged and must gain knowledge afresh at the place where he is going before he can measure up to his former efficiency.

Unfortunate Factory Sites

While the general principles which govern the advantages or disadvantages of a factory's site are well known, such as shipping facilities, proximity to raw material and finished-product markets, natural advantages, as land, water power, etc., and the supply of skilled and unskilled labor, still how often do we see manufacturing plants erected in locations where most of these advantages are wanting. Such unfortunate selections of site frequently result in disaster, although there are brilliant exceptions. In general, however, it is far from wise to discount these elements.

One of the most important is that of labor. Workmen and their families will live under the best conditions which they can obtain for themselves. If the factory is located in a sparsely settled neighborhood without having accommodations in easy reach, or if the surroundings of the towns are purely residential and are therefore out of harmony with the life of the factory worker, or if the means of transportation are such that a long walk must be taken from the nearest railway station or electric-car line, the best labor will not be attracted under normal business conditions. There have been instances where heroic efforts have been made along the lines of industrial betterment in order to compensate for the living conditions around the plant. In general such efforts have been dismal failures. It is not wise to determine upon a factory site merely because land is cheap or because it is owned by an influential director. It should be selected because of its advantages for the location of the specific manufacturing business which is to be carried on, and for no other reason.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A Lathe with All-geared Head

The illustrations show two lathes with all-geared heads, the one to the left with constant-speed pulley drive and that to the right with geared motor drive. The driving pulley (or gear, in the motor-driven machine) is placed on the end of the back-gear shaft. Twelve different speeds are provided, six with and six without back gears. A speed plate on the headstock shows the different speeds available and the correct positions of the levers for each.

The headstock is cast in two parts, the lower section forming a reservoir in which the speed-changing gears are constantly immersed in oil. The upper part acts as a cover for the gears and a brace for the heads. It is easily removed, leaving the gear exposed to view.

The driving pulley is of large diameter and wide face, and the maximum power is available at all speeds. A friction clutch is interposed between the first pair of driving gears, operated by the lever at the left of the headstock, so that practically the entire driving mechanism can be instantly stopped, leaving the pulley running idle.

The remaining gears are engaged by shifting those on the spindle to the right or left, as required, by means of the lever at the front of the head. No clutches are used between these gears, which engage by direct contact, and when throwing them in the friction clutch should be disengaged. This operation is practically instantaneous, consequently no time is lost in changing speeds.

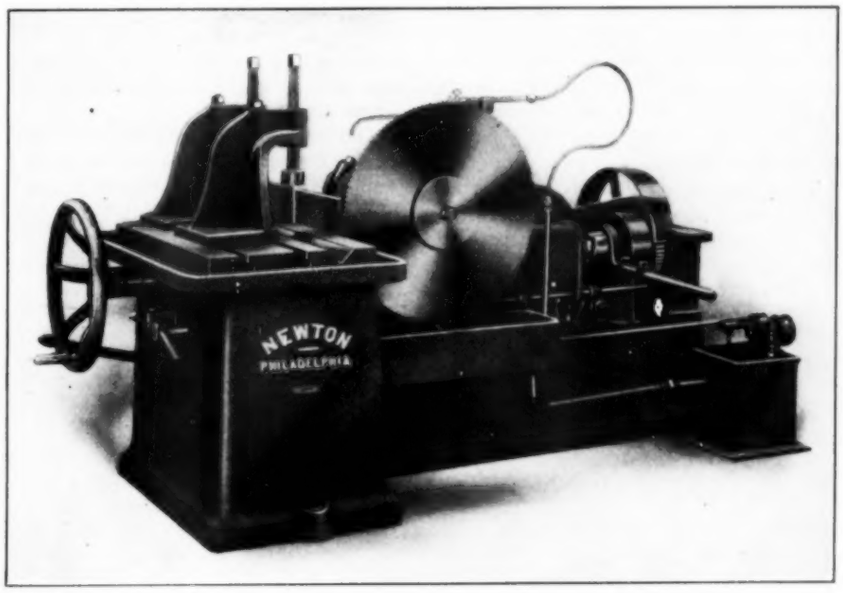
The spindle is of crucible steel and runs in hard phosphor-bronze boxes, ample oiling facilities being provided. The gears required are ten in all, only four being employed at one time, and the changes from one speed to another can be instantly made.

Except for the method of driving, the lathes are identical. They are built in sizes from 14- to 36-inch swing inclusive, by the Hamilton Machine Tool Company, Hamilton, Ohio.

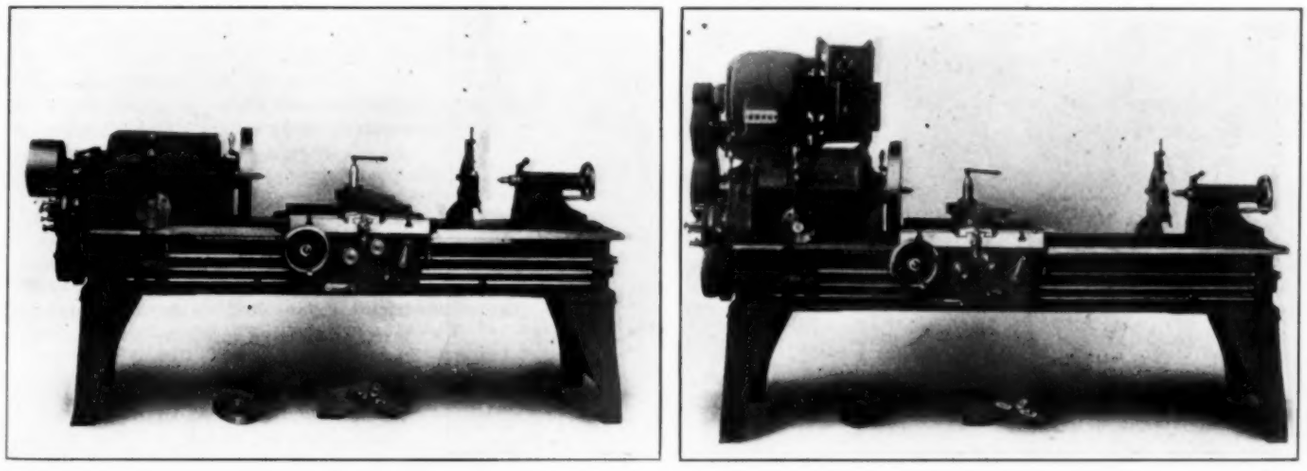
A Cutting-off Machine

The illustration shows a new design of cold-saw cutting-off machine. While it is shown with the plain saw blade it is designed to carry inserted tooth saws. The saw is driven by six pins inserted in the spindle. The drive is through steel spur gearing, a hardened-steel worm and bronze worm wheel having a ratio of 37⅓ to 1 from the pulley at the right-hand end of the bed. Provision is made so that a motor can be mounted at the end of the bed and either belted or geared to the driving shaft.

The table is surrounded by a pan to catch the lubricant and return it to the trough directly beneath the saw, where it is strained into the reservoir and pumped back onto the saw again.



A CUTTING-OFF MACHINE



A LATHE WITH ALL-GEARED HEAD

The saw carriage has variable automatic feed and power quick return with adjustable stops which can be set to throw out the feed at any desired point. The control of the machine is concentrated at the forward end so that hand adjustment by hand wheel can be obtained, and the feed engaged or disengaged by the lever shown just alongside of hand wheel. The lever on the opposite side of the bed is used to control the rate of feed. The machine has a capacity for round stock up to 7½ inches in diameter, and if the inserted tooth-saw blade will stand the amount of pressure necessarily exerted, a piece of this diameter can be cut off in as many minutes, although the machine has a maximum feed of 1½ inches per minute. This machine weighs approximately 5000 pounds, and is built by the Newton Machine Tool Works, Inc., 24th and Vine streets, Philadelphia, Penn.

A Rolling Machine

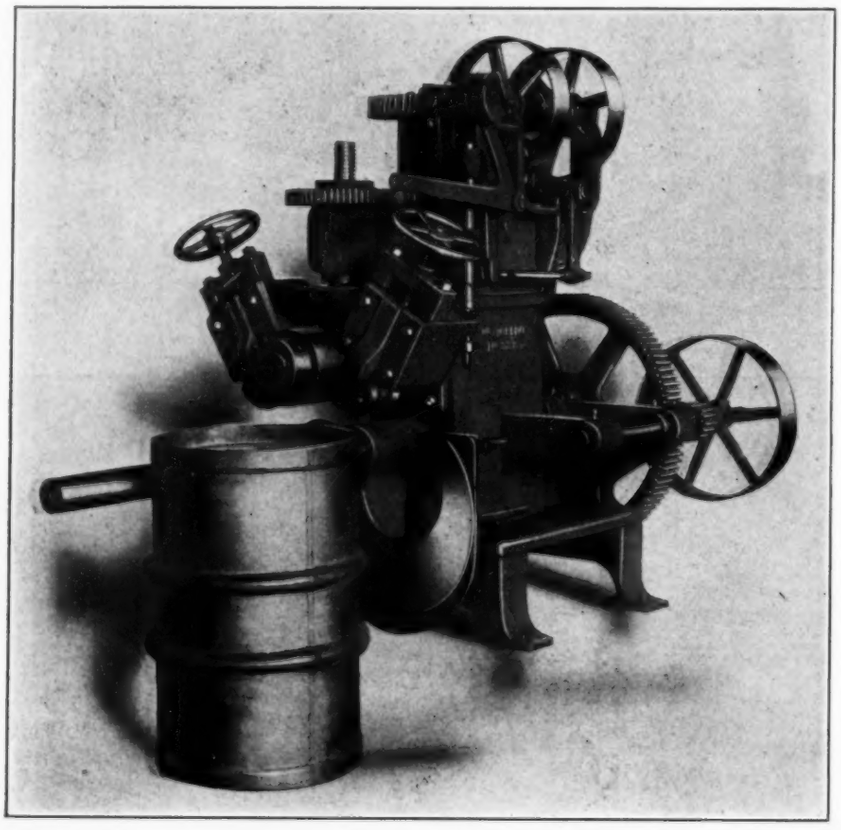
The illustration shows a new machine designed for rolling the large beads on steel oil barrels, also the shoulders at each end for supporting the heads. This machine is fitted with two parallel shafts connected at the rear end with gears. These shafts support the upper and lower rolls made of tool steel hardened.

The cylinders are first prepared in their plain, smooth shape, and placed in position on the machine, the adjustable apron in front of the machine acting as a guide.

The machine is fitted with an automatic lifting attachment operated by reverse clutch mechanism which necessitates starting only by the operator. The upper shaft, or head, then descends automatically to the work and finishes the rolling of the beads when the clutch is automatically reversed by striking a stop which is set to the correct position at the lower end of the travel of the head. This stop automatically reverses the lever which throws the clutch mechanism to the opposite side, when the head is elevated to the required hight, where it is stopped automatically.

It requires about one minute to roll each bead or shoulder. The machine will handle about 30 cylinders or barrels per hour, and can work metal as heavy as 14 gage, varying in diameter from 12 to 36 inches.

The machine is built by the Toledo Machine and Tool Company, Toledo, Ohio.



A ROLLING MACHINE

A New Electric Glue Pot

The electric glue pot recently placed on the market by the General Electric Company, Schenectady, N. Y., embodies a new and interesting feature of design, which is found only in electric glue pots of this make, namely the elimination of the water jacket.

The water jacket is a necessary feature of the ordinary glue pot, inasmuch as this water bath both serves to distribute the heat evenly to all parts of the glue, and to prevent it from becoming overheated. While the water-jacket was necessary, it was the cause of so much trouble as to render the ordinary and the earlier types of electric glue pots practically inoperative, when viewed from the standpoint of economy and satisfaction.

The elimination in the General Electric glue pot of the inefficient, unsatisfactory

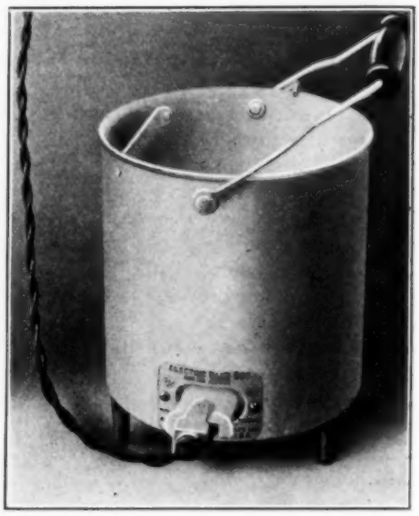


FIG. 1. 2-QUART ELECTRIC GLUE POT

FIG. 2. THE DIFFERENT PARTS READY TO ASSEMBLE

water jacket has been made possible by the adoption of a casting of pure aluminum which forms the glue pot proper. The high conductivity for heat, together with proper design of heating unit and proportioning of radiating surface, combine to keep the glue at the proper temperature, although the maximum temperature of the exterior and bottom of the pot never exceeds 180 degrees Fahrenheit.

The heating element is of the well known cartridge type, and possesses the characteristic features of simplicity, renewability and long life.

It has been found that a saving in electricity has resulted by the omission of the water-jacket—as much as 50 per cent. in the smaller sizes.

The practical efficiency of the General Electric glue pot and its superiority for result-producing work to the ordinary water-jacket type, render it particularly valuable to patternmakers.

Two concrete fly-wheels are in use at one of the plumbing stations of the Rand, near Johannesburg, S. A. Each of these weighs about 8000 pounds and measures 14 feet in diameter with a reinforced concrete rim. A cast-iron boss is secured to the shaft, and into this 16 arms, each made of 4-inch pipe, are screwed. Near the outer ends of the arms a ring of ¼-inch iron plate is secured with lock nuts, and around the extreme ends of the arms is fixed a second sheet-iron ring, which performs the periphery of the wheel. The space between the two rings is filled with concrete. The concrete rim is reinforced with four ¼-inch rods. The rim alone weighs about 6000 pounds. As the wheels make only 20 revolutions per minute their use involves no risk of serious accident, and they are reported to have proved very satisfactory.—*Cement Age*

Trade Catalogs

George Nash Company, 217 Pearl street, New York. Catalog and price list of Dick files. Illustrated, 16 pages, 6x9 inches.

The Hamilton Machine Tool Company, Hamilton, Ohio. Bound bulletins describing lathes, planers, shapers, upright and radial drills. Illustrated, 9½x11 inches.

Jacobson Machine Manufacturing Company, Warren, Pa. Bulletin F, illustrating and describing gas and gasoline engines, hit and miss type. 16 pages, 6x9 inches.

Manufacturers

A new factory will be built for the Davenport (Iowa) Wagon Company.

The Illinois Showcase Works, Chicago, Ill., will build a four-story factory.

The Los Angeles Can Company, Los Angeles, Cal., will erect a three story addition to its plant.

J. R. Good & Company, Colfax, Washington, are erecting an addition to their woodworking plant.

The Luitweiler Pumping Engine Company, of Los Angeles, Cal., is seeking a site in Santa Monica.

The Washington Stove Works, Everett, Washington, will install equipment for the manufacture of steel ranges.

The Metcalf Carbide Feed Acetylene Gas Generator Company, Middletown, Cal., will erect a new and larger plant.

Kitselman Bros., Muncie, Ind., will establish a plant for the manufacture of wire, wire fencing and nails in Lanett, Ala.

The Charlotte (Tenn.) Roller Mill Company will install planing equipment and manufacture ceiling, flooring, siding, etc.

The National Hollow Brake Beam Company, with headquarters in Chicago, will locate a plant in Joliet to employ 200 men.

The Augusta (Ga.) Mattress and Manufacturing Company will erect a building for the manufacture of springs and spring beds.

Butler Brothers of Chicago and St. Louis will locate a plant in Boyne City, Mich., for the manufacture of woodenware and novelties.

The Bluff City Lumber Company, Pine Bluff, Ark., will rebuild plant destroyed by fire some time ago, at a cost of about $100,000.

It is thought that work will be shortly resumed on the new foundry building being constructed for the Fort Wayne (Ind.) Electric Works.

The Huntingdon Wood Manufacturing Company, Huntingdon, Tenn., a new concern, will will erect a factory for the manufacture of boxes.

The Kirby Lumber Company, of Houston, Texas, will install a woodworking plant in connection with its planing mill at Beaumont, Texas.

Wm. and R. P. Johnston, Asheville, N. C., contemplate installing equipment for the manufacture of colonial columns, conduits, pump logs, etc.

It is stated that the Delaware Seamless Tube Company, of Auburn, Pa., is completing arrangements for the construction of a plant at Sarnia, Ont.

Fire at the crate factory of Alexander Bros., Jacksonville, Texas, destroyed the main building which contained all the machinery. It will be rebuilt.

The Nelson Iron Works, Marshfield, Ore., builders of gas engines, saw mill machinery, etc., have incorporated under the laws of the state of Oregon.

The Pueblo (Colo.) Foundry and Machine Company will erect an addition to be used for the manufacture of steel castings. This will cost $75,000.

National Saw Filing Machine Company, Lexington, N. C., has been organized to manufacture hand saw-filing machines. E. J. Buchanan, president.

The Grand Trunk System intends to expend about $3,000,000 for repair shops at Battle Creek, Mich., it is stated. T. T. Irving, resident engineer, Detroit, Mich.

The Kansas City, Mexico & Orient Railway will erect roundhouses and passenger station in San Angelo. C. H. Webster, Sweetwater, Texas, city engineer.

Fire at the plant of the Dayton (Ohio) Motor Car Company caused a loss of about $150,000 to building, stock and machinery. The damaged parts will be rebuilt at once.

The Redwood Kettle Company, Houston, Texas, has been incorporated with $50,000 capital to manufacture a patented kettle and air-tight heaters. A. G. Redwood, president.

The main building of the Electric Cable Company's plant at Bridgeport, Conn., was partly destroyed by fire, causing a damage of about $150,000 to machinery, etc. Repairs will be begun at once.

The Spiro Hardware Company, Birmingham, Ala., has been incorporated to succeed S. Spiro and contemplates installing machinery for the manufacture of sheet-metal shingles, cornice, etc.

The De Lamorton Machinery Manufacturing Company is being formed at Tampa, Fla., to manufacture sawmill and woodworking machinery, mechanics tools, etc. O. H. De Lamorton, manager.

The Missouri Box and Label Company, St. Louis, Mo., has been incorporated to manufacture boxes. Capital $10,000. Incorporators, Wm. Hattenhorst, Clarence Sizemore, and C. B. Macaulay.

The Merchants' Box Company, New Orleans, La., recently incorporated, contemplates installing two additional motors, printing machine and planer. F. F. Wigginton, president.

T. C. Augustine, of St, Joseph, Mo., is reported to be organizing a company for the purpose of establishing a plant to manufacture boiler-plate, flat and angle iron, etc. The plant is to cost about $500,000.

The Louisiana & Northwest railroad is reported to erect shops and make other improvements at Homer, La. About $100,000 will be expended. J. A. Knox, Magnolia, Ark., is chief engineer.

The Illinois Valley Motor Company, Ottawa, Ill., is being formed by Shanley Bros. and J. W. Dies of that place to establish a plant for the manufacture of engines and do general repair and machine shop work. Building has been leased.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa

If you use small gears in large quantities, write Berry and Parker, Erie, Pa.

Experienced draftsman wants home work. Box 954, AMERICAN MACHINIST.

Wanted—American Machinist, No. 45, Volume 30. Canadian Locomotive Co., Kingston, Ont.

We buy or pay royalty for good patented machine or tool. Box 282, AMERICAN MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—Names of manufacturers of automatic filling machines. Address F. J. L., 275 Covert Ave., Brooklyn.

Special machinery designed and built; duplicate parts, tools, jigs and dies. The Wade Machine Co., 133 Oliver St., Boston.

Model making. Patented machines manufactured on royalty. Rotary File & Machine Co., 589 Kent Ave., Brooklyn, N. Y.

Wanted—Second-hand Rivett back geared 8-inch precision lathe and attachments in good condition. C. Nutter, Topeka, Kan.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Special machines designed and built; duplicate parts, models or experimental work. Mantie, Park Ave. and 129th St., New York.

Inventions, novelties, ideas, etc., developed; special machines designed. Albert Pott, M. E., 23 Platt St., New York, and Waterbury, Conn.

If you have a copy of March 7, 1907 AMERICAN MACHINIST we'll give you fifteen cents for it. AMERICAN MACHINIST, 505 Pearl St., New York.

Automatic machinery designed; special purpose machines; working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Wanted—Some novelty or small machine to manufacture. Will buy patent, or territory rights. Capital Foundry & Machine Co., Frankfort, Ky.

Gears cut to order, bevel, spur and mitre, on Bilgram and Gleason machines. Complete gears furnished. The Cincinnati Gear Works, Murdock Building, Cincinnati, Ohio.

Air, ammonia compressors, steam, gas, oil engines, turbines, centrifugal pumps, special machinery designed, inventions developed. Box 951, AMERICAN MACHINIST.

Special machinery designed, new ideas developed to practical results; tell me the conditions you wish to improve and I will do the rest. Box 950, AMERICAN MACHINIST.

Wanted—A copy of Volume 9 of the Transactions of the American Society of Mechanical Engineers, dated 1887 and 1888. Address, Box 29, Providence, R. I., stating price and condition of volume.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

New British patent laws; high-class engineering firm with modern plant is open to quote favorable terms for building engineering specialties or machine tools in England. The Simplex Engineering Co., Ltd., Trafford Park, Manchester.

Wanted—Work for well-equipped machine shop. Have twenty machines idle. General repairs, die-making, mill-wright work, dies, models, experimental work and manufacturing. Boyce, 584 Hudson St., New York City. Phone 860 Chelsea.

Salesman for your state for remarkable fuel and labor saving device for boilers selling for $50. Over 20,000 in use in the U. S. and Canada. Also hardware salesman to carry as side line our wonderful newly patented spirit level. Diamond Power Specialty Co., Detroit, Mich.

Foreign Representative—Young man of both practical and commercial experience here and abroad is desirous of representing some engineering and manufacturing concern in France or Germany. Speaks French and German fluently. Willing to invest some money in the enterprise. Will entertain private interview with any concern presenting A-1 proposition. Best of references. Box 959, AMERICAN MACH.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Competent draftsman on general machinery desires a job. Good designer and estimator. Rapid detailer. Familiar with patent office work. Technical education, practical machinist. Box 964, AMERICAN MACHINIST.

ILLINOIS

Superintendent, 38, practical mechanic, highly successful manager of men, interchangeable work, moderate salary. Box 933, AM. MACH.

Designer on machine tools, special machinery and jigs and fixtures. Experienced and thoroughly competent and reliable. Box 973, AMERICAN MACHINIST.

Situation Wanted—By an up-to-date foundry foreman, wide range of experience in all branches of foundry work. Am open for engagement. A-1 reference. Box 956, AMERICAN MACHINIST.

IOWA

Position as patternshop foreman or superintendent of small manufacturing plant by man 33 years of age with some technical education and experience in drafting and designing. Box 962, AMERICAN MACHINIST.

MASSACHUSETTS

Assistant to manager or superintendent by college man, 28, seven years' excellent experience. Box 970, AMERICAN MACHINIST.

First-class metal patternmaker, experienced on hand and moulding-machine patterns, wishes position. Will go anywhere. Box 938, AM. MC.

Designer wishes to make a change, six years' experience in automatic tool machinery, jigs, fixtures, and tools. Any location satisfactory. Box 961, AMERICAN MACHINIST.

Superintendent or works manager, age 39, practical mechanic, eighteen years' experience, desires change. Able executive, organizer and cost reducer. Box 969, AMER. MACHINIST.

Wanted, supervision by an active expert mechanic, a genuine cost reducer, productive and up-to-date organizer and systematizer. Address "Systematizer," AMERICAN MACHINIST.

Designer and engineer on light and heavy machinery; inventive and manufacturing development; modern shop processes; 30 years old; eight years in last position as chief, twelve years practical experience; open for responsible position April 1st. Box 963, AMERICAN MACHINIST.

NEW JERSEY

Chief draftsman, experienced on steam, gas, oil engines, turbines, air, ammonia compressors, centrifugal pumps, inventor and executive, wants responsible position. Box 966, AM. MACH.

Engineer, superintendent, chief draftsman desiring change, specialist in coal and ore handling, elevating and conveying machinery, traveling cranes, and industrial railway design construction and erection, successful in handling labor. Box 920, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman wishes position. Address Box 972, AMERICAN MACHINIST.

Draftsman, mechanical engineer, expert automatic machine designer. Box 967, AM. MACH.

Draftsman mechanic wants position. 6 years' shop and draftingroom experience. Box 955, A.M.

Draftsman wants position, six years' drafting and five years machine shop experience. Box 965, AMERICAN MACHINIST.

First-class designing draftsman wants position, experienced in Corliss steam air compressors, rock drills and oil engines. A-1 references. Box 945, AMERICAN MACHINIST.

Situation wanted as superintendent or assistant superintendent by an expert mechanic with wide experience in up-to-date concerns. First-class draftsman and designer, practical toolmaker and good manager of help. Box 947, AMERICAN MACHINIST.

PENNSYLVANIA

Machine designer, eight years' experience, desires position. Box 960, AMERICAN MACHINIST.

Mechanical engineer, experienced chief draftsman and engineer in charge of construction seeks responsible work. Box 927, AMER. MACHINIST.

Draftsman, college graduate with good experience in hoisting and conveying machinery, cranes, charging machines and structural work, desires position. Box 921, AMERICAN MACH.

Position desired, chief engineer or superintendent, manufacture gasoline trucks, engines. Four years continuous experience, three years other work. Technical graduate, member A. S. M. E., systematic. Box 968, AM. MACHINIST.

Designer and draftsman desires engagement, tools, special and general machinery, experienced on paper bag and envelope machinery and power transmission apparatus, good executive. Member A. S. M. E. Box 936, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted, man thoroughly posted on the production capacity of machine tools to set premium time limits in large electrical establishment. Must have had experience and be systematic. Apply with references and salary wanted to Box 948, AMERICAN MACHINIST.

Superintendent, with experience in building woodworking machinery preferred, capable of taking full charge of the manufacturing, where 200 hands are employed, familiar with modern shop methods and able to produce at a minimum cost; state age, experience and salary expected with references. Address, "Canada," AM. MACH.

CONNECTICUT

Wanted—A competent designer, one possessing unusual ability in the developing of mechanical movements and experienced in the class of work such as would be associated with some one or more of the following classes of work: sewing machines, adding machines, typewriters or cash registers. A good knowledge of the manufacture of parts would also lend advantage. The right person can secure a permanent position with a very large, progressive and prosperous concern, and can be assured proper compensation for the quality of service afforded. Age preferred between 30 and 40. Locality, Connecticut. Box 971, AMERICAN MACHINIST.

MASSACHUSETTS

Pump Doctors—Expert repair men wanted by manufacturers of trade steam, power, electric driven pumps and small engines. Box 958, AMERICAN MACHINIST.

NEW JERSEY

Wanted—First-class designer and originator on hydraulic work, pumping engines, air and steam machinery. Must be fully competent to work out designs, practical experience, ability to redesign, develop and improve requirements. Address with full details, Box 957, AM. MACH.

For Sale

For Sale—Well equipped general machine shop in New Jersey; employing 15 to 20 hands; good reason for selling. R., Box 1216, New York City.

Good will and tools of completely equipped machine shop, centrally located in lower part of New York City. No dealers need apply. Box 949, AMERICAN MACHINIST.

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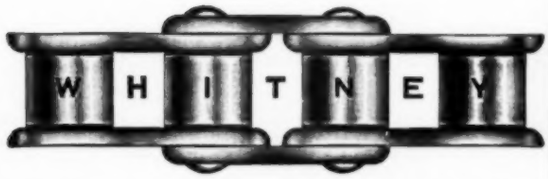

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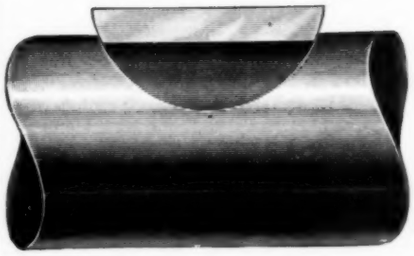

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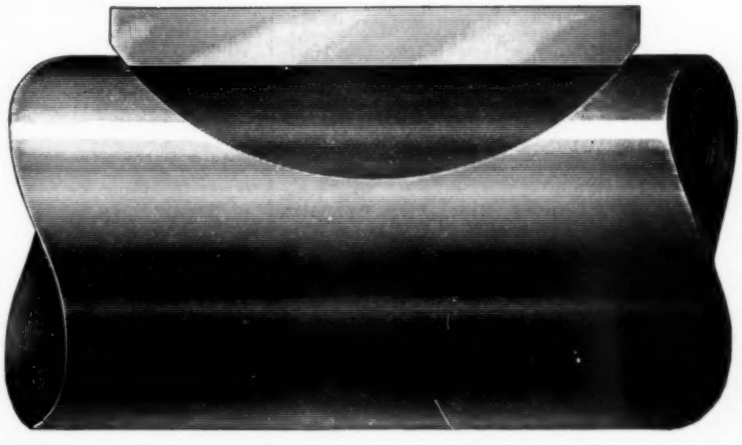

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Safety Emery Wheel Co., Springfield, O.

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Dies, Sub-Press—*Continued.*

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U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Boiler

American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric

Chicago Pneumatic Tool Co., Chicago, Ill.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Ct.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.

Drilling Machines, Portable—*Continued.*

Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Drilling Machines, Turret

Fay Machine Tool Co., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Drills, Center

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.